Corporate Employee Attrition Rate Analysis

A PROJECT COMPONENT REPORT

Submitted by

KRISHN KANT (Reg.No.7309730919104045)

KOULIK JANA (Reg.No.7309730919104043)

MD AL MAMUN (Reg.No.7309730919104051)

MD SARFARAZ ALOM (Reg.No.7309730919104053)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

EXCEL ENGINEERING COLLEGE (Autonomous),

KOMARAPALAYAM

(An Autonomous Institution affiliated to Anna University Chennai)

1. INTRODUCTION

Corporate companies and Industries are the two main parts that support to the progress and growth of the Country. Workforce or manpower are very important constituent of an organization. The performance and the growth of the company depend on the sustainability of the employees. Attrition and Re tension are two main opposite phenomenon which serves different purposes but the crux of the connection is that one makes way for the other. World markets are becoming competitive with time which has changed the culture of the workspace. The presence of work force , emergent imbalance in the supply and the demand of qualified personnel and increased emphasis on work life balance have created challenges for the company's HR and manager to identify the right person to hirefor right position. Attrition and retentions are the two faces that represents the way to identify the business employments trends, overall business growth, motivation and growth. It is observed as in global competitive organization are investing considerable amount of intrest , time and money on the employe

attrition because losing a valid employee negative impact in the form of knowledgevalue , apprehensive colleagues, lost capital, loss of good name of the organization and leads to the failure of the company or organization.

1.1 PROJECT OVERVIEW

The key to success to the organization is attracting and retaining top talented. As an HR it is one of the key tasks to determine which factor keeps the employee in the company and which prompts others to leave. Given in the data is a set of data points on the employees who are either currently workingwithin or have resigned the company. The objective is to identify and improvethese factors to prevent hte loss of good people in the organization.

1.2 PURPOSE

- To analyze the factors that causes the employee attrition through predictive analysis and to give suggestions by modelling techniques to reduce the cause of retention.
- Visualization Charts are prepared to highlight the insights for the given dataset

- Creating dashboard for the HR and managers for understanding the reasons for attrition and to take necessary measures in the organization.

2. LITERATURE SURVEY

Employee attrition is referred as reduction in number of employees in an organization. For Corporate industry, employee attrition has become a known challenge since last two decades. Employees leave the organization for various reasons. A few reasons are, demand of high salary, change in technology or role, professional challenges etc. High attrition leads to expense over multiple attributes and functions in the company. Recruitment, Training and Development costs increases overall cost on the employees.

2.1 EXISTING PROBLEM

In recent years, the employer and employee both have lost belief in each other. The former feels that employee can leave the organization anytime and the latter apprehends that he or she can be expelled anytime by the former one. Whosoever is responsible, irrespective of this; loss of workforce is inevitable. This loss of workforce for any reason is called attrition. Irrespective of the kind

of industry or the structure of the organization, attrition is a common problem in every organization which not only hampers production but also results in heavy long-run costs and loss of goodwill to the organization. Therefore, there arises a need to delve into this multi-dimensional problem and come out with feasible solutions

2.2 REFERENCES

Attrition Defined Attrition, in Human Resource Management (HRM), refers to the situation of employees leaving the company. It is measured with a measuring unit called attrition rate, which calculates the number of employees leaving the company (either resigning voluntarily or involuntarily laid off by the company). (www.mbaskool.com/business-concepts/human-resources, 2013).

Employee attrition & retention is manifestation of employee movement in an organization, which is deliberated by researcher in HR. They are two sides of same coin. Employee attrition & retention may be result of the negative or positive influence of the various factors (Zhang, 2005).

According to Cascio and W.Bourdeau (2008) voluntary attrition happens when an employee resigns an organization to grab another career opportunity, he may relocate with his family to different place or simply leave the organization for his

personal reasons. Retirement is one biggest form of voluntary turnover, i.e leaving a job at his own will. Voluntary turnover is a serious issue for modern organizations these days because experienced and intellectual capital is increasingly critical for sustained competitiveness (Boudreau & Ramstad, 2007; Lepak & Snell, 2002).

Corey Harris (Walden University 2018) researched on "Employee Retention Strategies in the Information Technology Industry" and mentioned that

"Productivity declines when employees voluntarily leave an organization" Dr. Shikha N. Khera1 , Ms. Karishma Gulati2 (Delhi 2012), concluded in their study on "Human Resource Information System and its impact on Human Resource

Planning: A perceptual analysis of Information Technology companies" that Being an information system of human resources, it can store voluminous data about the employees, that not only helps in identifying the occupied and unoccupied positions but also whether the person at particular position is fit for the job or not.

Hardik P. K. (2016) , researched on "a study on employee attrition: with special reference to Kerala IT Industry". His research examined the relationship between organizational factors and attrition of IT professional's The result can conclude that the organizational factors played significant role in predicting the variance in turnover intention (attrition) of Kerala IT professionals. Therefore,

the HR mangers in IT organizations may take into consideration the problems with organizational factors of their workers to reduce the turnover intention of the skilled employees.

Bodjrenou Kossivi, Ming Xu, Bomboma Kalgora (May 2016) published "Study on Determining Factors of Employee Retention". The study concluded: Employees are the most valuable assets of an organization. Their significance to organizations calls for not only the need to attract the best talents Mukt Shabd Journal Volume IX, Issue VII, JULY/2020 ISSN NO : 2347-3150 Page No : 2752 but also the necessity to retain them for a long term. Broad factors are development opportunities, compensation, work-life balance, management/leadership, work environment, social support, autonomy, training, and development.

Brijesh Kishore Goswami, Sushmita Jha (April 2012) in their study on "Attrition Issues and Retention Challenges of Employees" have stated that, Organizationsplanning should be giving close attention to why attrition is occurring in the pre-set. To ignore why people are leaving the organization is to ignore the

organization's greatest asset – its people. People are needed to accomplish the task, but people are more than just tasks they perform. They are dreams, hopes, ambitions, creativity, and innovation.

To recognize and cultivate these valuable assets is one of the surest ways to build an organization that leads rather than follows in domestic and global

markets. Thus, Organizations should create an environment that fosters ample growth opportunities, appreciation for the work accomplished and a friendly cooperative atmosphere that makes an employee feel connected in every respect to the organization.

Retention plans are an inexpensive way of enhancing workplace productivity and engaging employees emotionally. Proficient employees keep the quality up and business operations run smoothly along with the cost saving in the longer run paper.

S.Guru Vignesh, V.Sarojini, S.Vetrive (Jan 2018),in “Employee Attrition and Employee RetentionChallenges & Suggestions” state that, retention plans are an inexpensive way of enhancing workplace productivity and engaging employees emotionally. Proficient employees keep the quality up and business operations run smoothly along with the cost saving in the longer run.

2.3 PROBLEM STATEMENT DEFINITION

Problem Statement

Problem

- A large company named XYZ, employs, at any given point of time, around 4000 employees. However, every year, around 15% of its employees leave the company and need to be replaced with the talent pool available in the job market. The management believes that this level of attrition (employees leaving, either on their own or because they got fired) is bad for the company

Current situation

- 1.The former employees' projects get delayed, which makes it difficult to meet timelines, resulting in a reputation loss among consumers and partners
- 2.A sizeable department has to be maintained, for the purposes of recruiting new talent
- 3.More often than not, the new employees have to be trained for the job and/or given time to acclimatise themselves to the company

Corporate consern

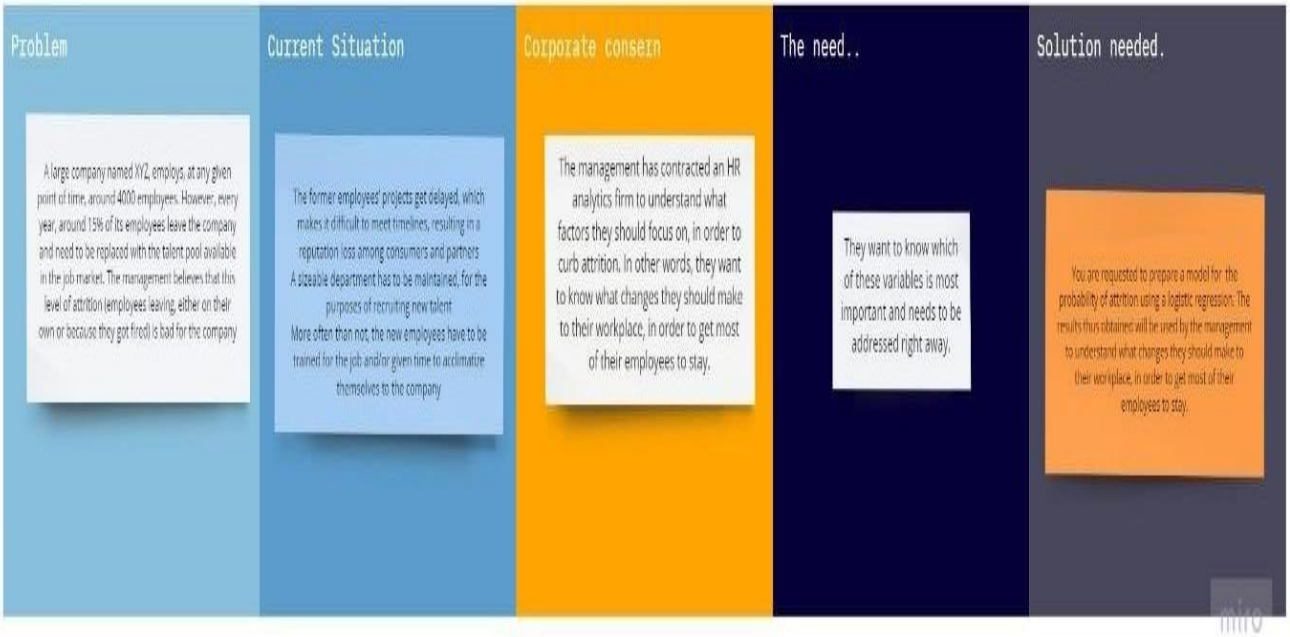
- the management has contracted an HR analytics firm to understand what factors they should focus on, in order to curb attrition. In other words, they want to know what changes they should make to their workplace, in order to get most of their employees to stay.

Needed...

- they want to know which of these variables is most important and needs to be addressed right away

Solution needed..

- You are required to model the probability of attrition using a logistic regression. The results thus obtained will be used by the management to understand what changes they should make to their workplace, in order to get most of their employees to stay.



A large company named XYZ, employs, at any given point of time, around 4000employees. However, every year, around 15% of its employees leave the company and need to be replaced with the talent pool available in the job market. The management believes that this level of attrition (employees leaving, either on their own or because they got fired) is bad for the company, because of the following reasons -

1. The former employees' projects get delayed, which makes it difficult to meet timelines, resulting in a reputation loss among consumers and partners
2. A sizeable department has to be maintained, for the purposes of recruiting new talent
3. More often than not, the new employees have to be trained for the job and/or given time to acclimatise themselves to the company

Hence, the management has contracted an HR analytics firm to understand what factors they should focus on, in order to curb attrition. In other words, they want to know what changes they should make to their workplace, in orderto get most of their employees to stay. Also, they want to know which of these variables is most important and needs to be addressed right away.

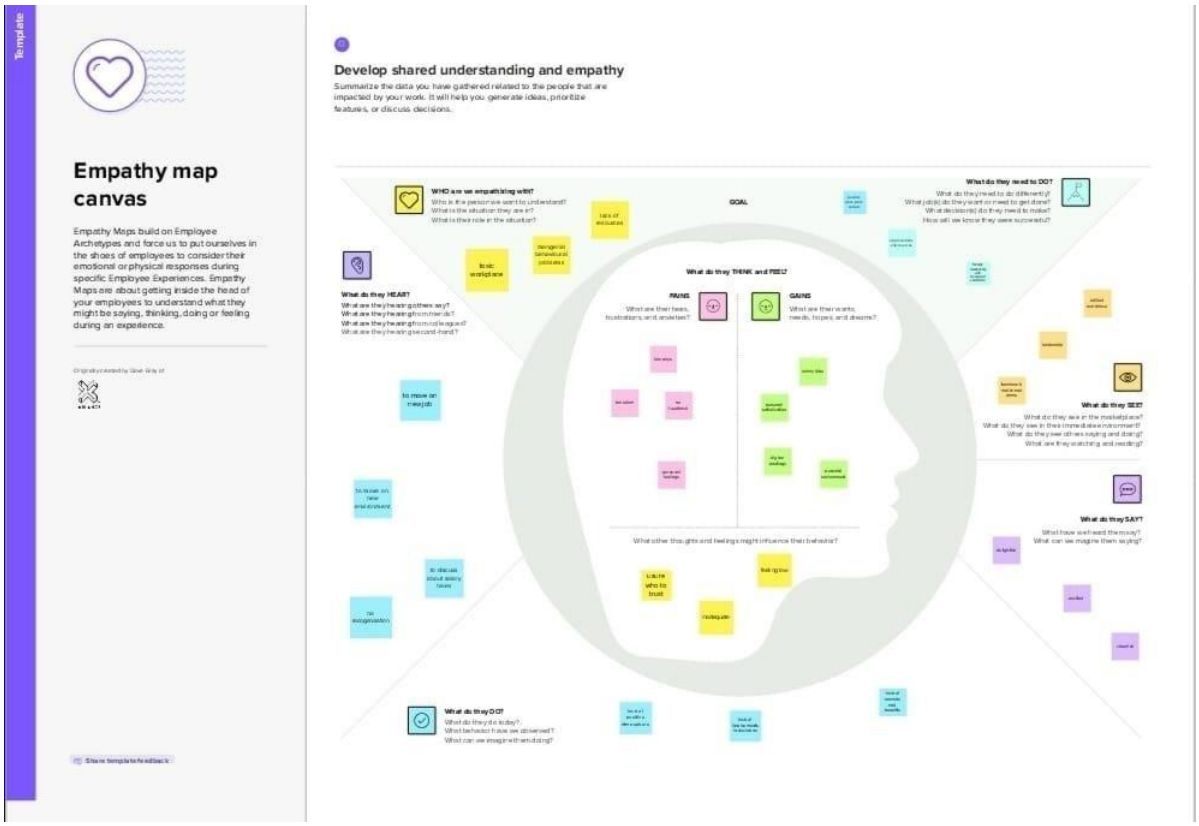
Since you are one of the star analysts at the firm, this project has been given to you.

Goal of the case study

You are required to model the probability of attrition using a logistic regression. The results thus obtained will be used by the management to understand what changes they should make to their workplace, in order to getmost of their employees to stay.

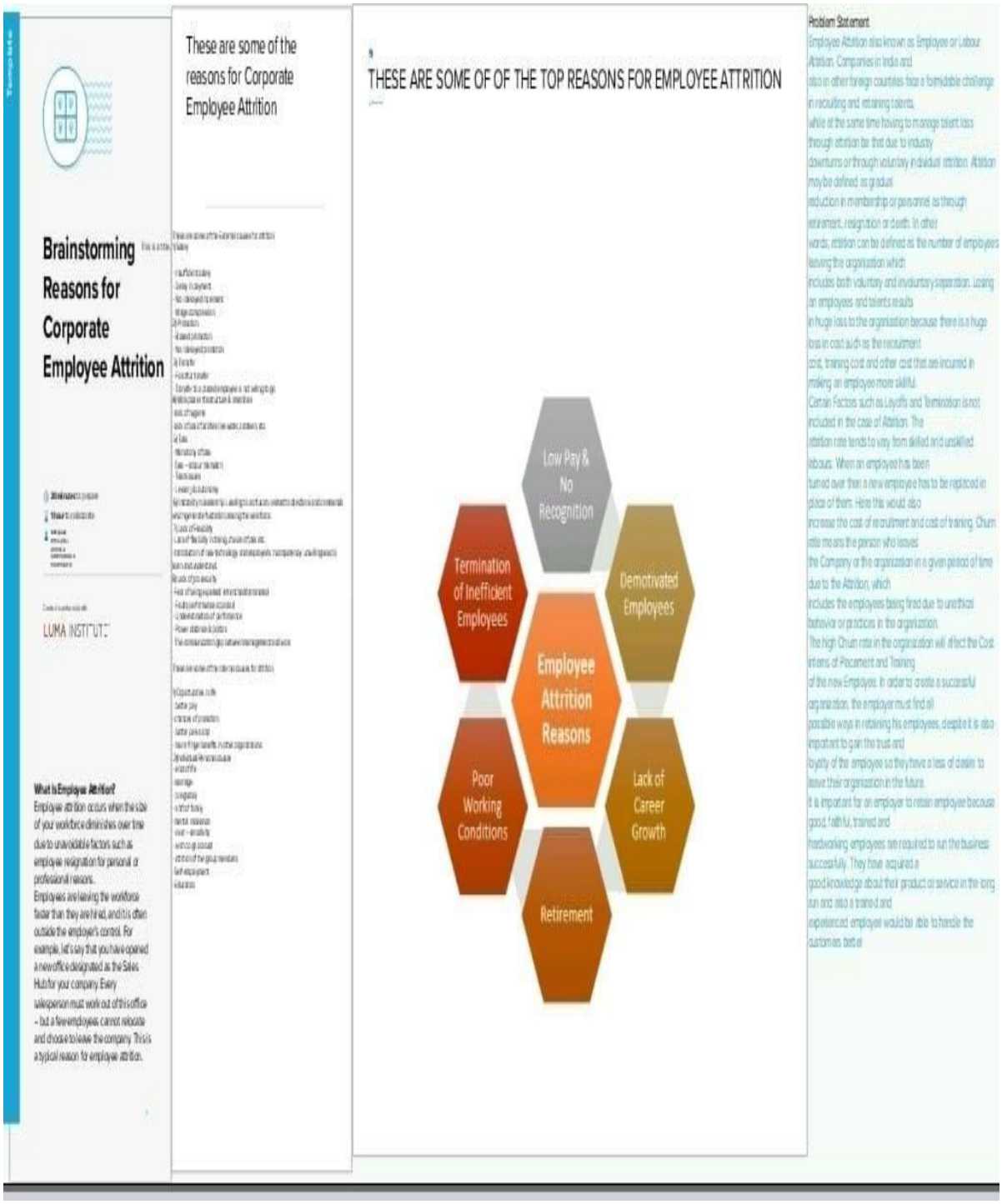
3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

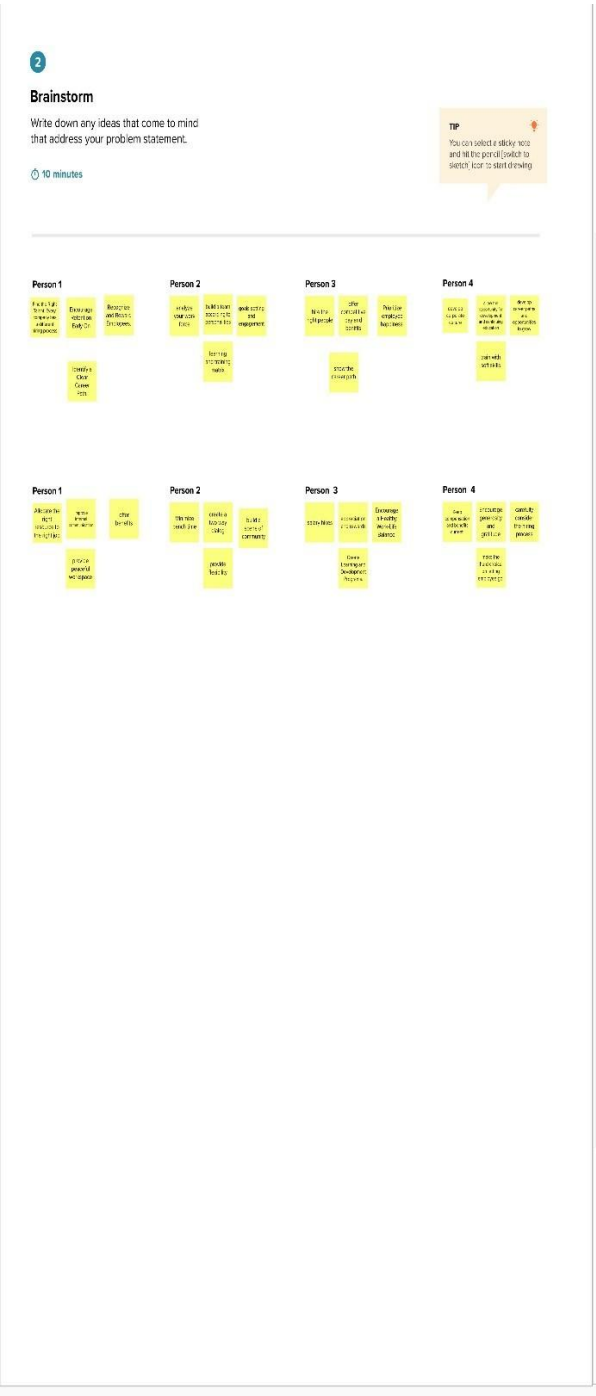


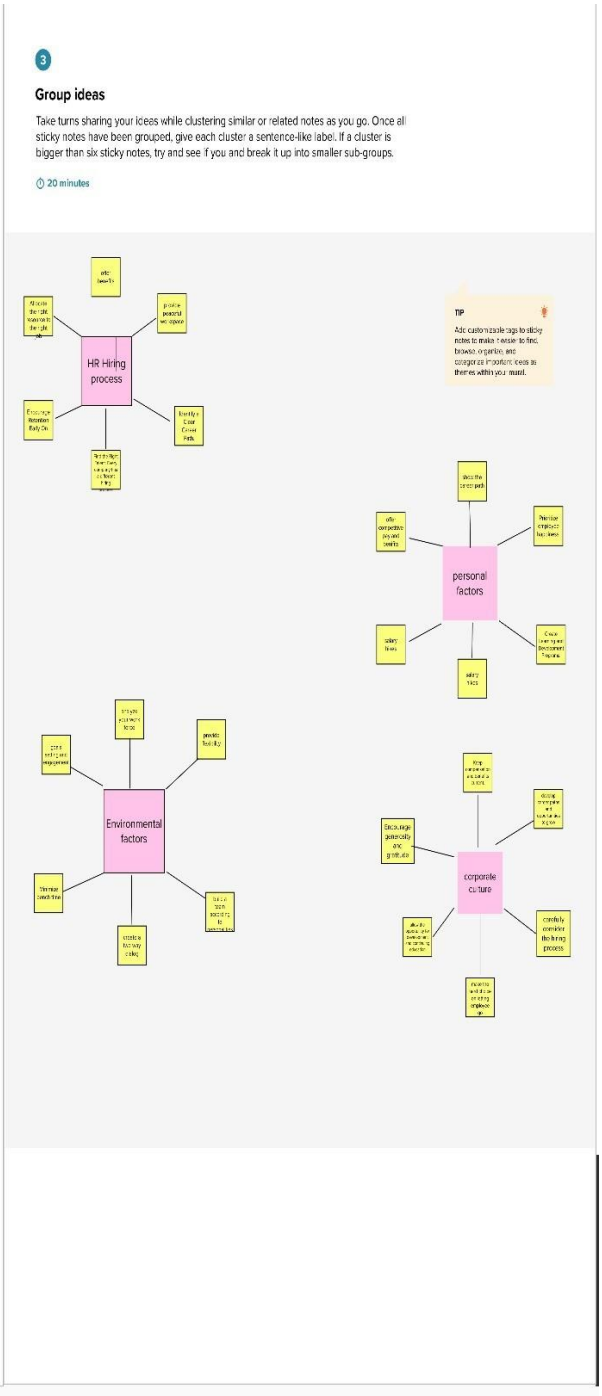
3.2 IDEATION & BRAINSTORMING

Step-1: Team Gathering, Collaboration and Select the Problem Statement

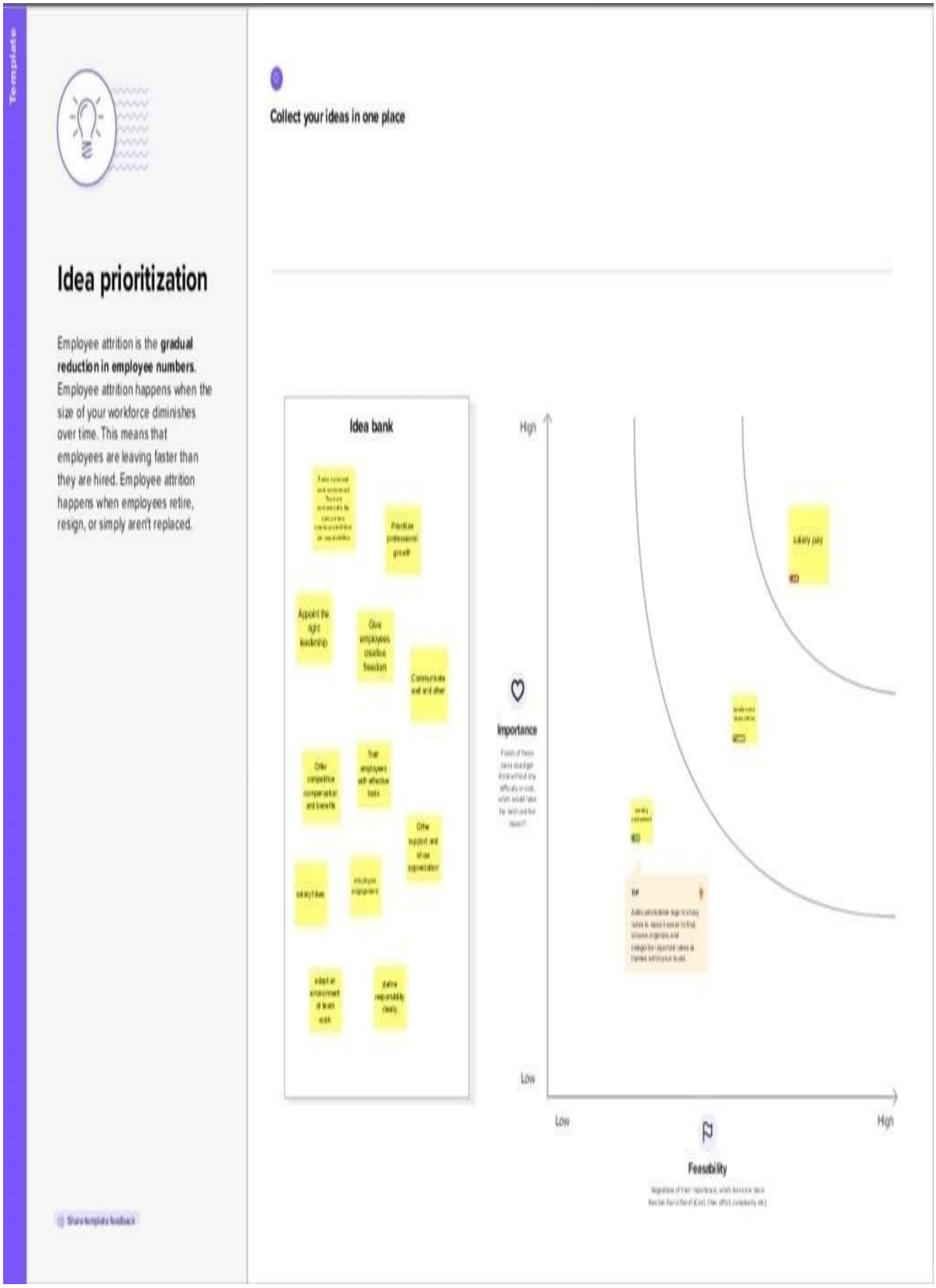


Step-2: Brainstorm, Idea Listing and Grouping





Step-3: Idea Prioritization



3.3 PROPOSED SOLUTION

S.No.	Parameter	Description

1.	Problem Statement (Problem to be solved)	A large company named XYZ, employs, at anygiven point of time, around 4000 employees. However, every year, around 15% of its employees leave the company and need to be replaced with the talent pool available in the job market. The management believes that this level of attrition (Employees leaving, either on their own or because they got fired) is bad for the company, because of the following reasons - 1. The former employees' projects get delayed, which makes it difficult to meet timelines, resulting in a reputation loss among consumers and partners 2. A sizeable department has to be maintained, for the purposes of recruiting new talent 3. More often than not, the new employees have to be trained for the job and/or given time to acclimatise themselves to the company Hence, the management has contracted an HR analytics firm to understand what factors they should focus on, in order to curb attrition. In other words, they want to know what changes they should make to their workplace, in order to get most of their employees to stay. Also, they want to know which of these variables is most important and needs to be addressed right away

2.	Idea / Solution description	You are required to model the probability of attrition using a logistic regression. The results thus obtained will be used by the management to understand what changes they should make to their workplace, in order to get most of their employees to stay
3.	Novelty / Uniqueness	The solution will give idea or changes that they should make to their workplace, in order to get most of their employees to stay.Also, they will come to know which of these variables is most important and needs to be addressed right away
4.	Social Impact / Customer Satisfaction	1. The former employees' projects will not be delayed, which makes it to produce on time, resulting in a good reputation among consumers and partners 2. A sizeable department will be maintained, for the purposes of recruiting new talent 3. the new employees will be trained for the job and/or given time to acclimatise themselves to the company
5.	Business Model (Revenue Model)	If there is no attrition in the company, then the revenue and the profit of the company gets increased.
6.	Scalability of theSolution	Analysis and Models will be helpful in understanding the reason for attrition and the steps to be taken by the company to reduce it

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

*) THE EMPLOYEE ATTRITION IS ONE OF THE GROWING PROBLEMS IN CORPORATES. WE MUST DO AN ANALYSIS FOR THE CAUSES OF ATTRITON.
*) ATTRITION IS OF TWO TYPES EXTERNAL AND INTERNAL CAUSES

6. CUSTOMER CONSTRAINTS CC

*)CORPORATE COMPANY FACE LOSS DUE TO REDUCED WORKING POWER.
*)PRODUCTS OR WORK THAT HAS TO BE DONE ON TIME GETS DELAYED DUE TO ATTRITION OF EMPLOYEE.
*)HR IS IN THE POSITION TO EXPLAIN THE EMPLOYEE ATTRITION ,BECAUSE OF THIS HIS JOB MAY BE DANGER ZONE

5. AVAILABLE SOLUTIONS AS

1)Hire the right people.
2)Keep up with the market rate and offer
3)competitive salaries and total compensation.
4)Closely monitor toxic employees.
5)Reward and recognize employees.
6)Offer flexibility.
7)Prioritize work-life balance.
8)Pay attention to employee engagement

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

THESE ARE PROBLEMS FACED BY THE EMPOLYEE THAT ARE SOME CAUSES FOR ATTRITON

1) LACK OF JOB SECURITY

2) LACK OF CAREER ADVANCEMENT

3) DESIRE FOR CHANGE IN NEW OPPORTUNITIES

4) ANTICIPATING HIGHER PAY

5) PROBLEMS WITH SUPERVISORS

9. PROBLEM ROOT CAUSE RC

THESE ARE SOME OF THE ROOT CAUSES FOR THE ATTRITION OF EMPLOYEE

1)Employees are overwhelmed by the amount of work.
2)Lack of recognition.
3)Company culture.
4)Poor relationship with the Manager.
5)Lack of flexibility.
6)Remuneration and benefits.
7)Poor learning and development opportunities.

7. BEHAVIOUR BE

Poorly behaved employees may be less productive, more prone to accidents, and more likely to cause conflict with others. This can lead to a decrease in morale and an increase in turnover. Additionally, poor work behavior can reflect poorly on a company and make it difficult to attract and retain top talent.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TR

Too much work and, subsequently, too much stress is also a major factor in an employee's decision to leave your organization and find work elsewhere

4. EMOTIONS: BEFORE / AFTER EM

Positive attrition refers to staff turnover that actually benefits the organization.

Negative attrition, especially in industries with the highest turnover rates, is expensive. The organization must once again recruit, assess, hire and train a new employee, and until the position is filled, team productivity declines.

10. YOUR SOLUTION SL

The solution to the problem can be identified using analysis and modelling techniques

8.CHANNELS of BEHAVIOUR CH

RESPONSIBILITY FOR THE CAUSES OF ATTRITION FALLS ON BOTH EMPLOYEES AS WELL AS COMPANIES.

SUGGESTIONS BASED ON THE ANALYSIS DONE, CAN BE USEFUL TO THE COMPANY FOR REDUCING THE ATTRITION RATE

NECESSARY ACTIONS MUST BE TAKEN IN FAVOR OF EMPLOYEES TO REDUCE ATTRITION OF EMPLOYEE IN CORPORATE

Identify strong TR & EM

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS:

Following are the functional requirements of the proposed solution.

FR No.	**Functional Requirement(Epic)**	**Sub Requirement (Story / Sub-Task)**
FR-1	Dataset	Sign up through Kaggle Registration through Gmail
FR-2	Uploading the dataset	Sign up into IBM Cloud AccountInvitation through mail id Sign up into IBM Cognos AnalyticsInvitation through mail id
FR-3	Data Visualization Charts	Sign up into IBM Cognos AnalyticsInvitation through mail id
FR-4	Coding	Sign in Jupyter Python coding - Jupyter
FR-4	Modelling and testing	Sign in Python Direct Collaboration through google collabs

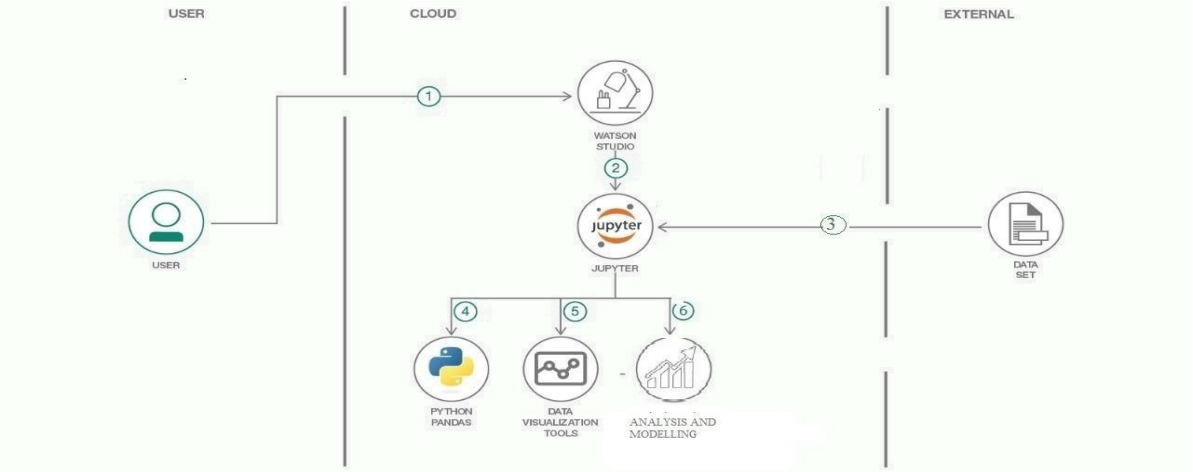
4.2 NON-FUNCTIONAL REQUIREMENTS:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR -1	**Usability**	The dataset is obtained from the external sources must be safe and recommended for analysis
NFR -2	**Security**	Organizations must protect their most critical business assets—your data—against unauthorized or unwanted use. They must combine people, processes, and technology to protect data throughout its lifecycle. Use a unified platform that integrates data security information across your entire enterprise and that ensures scalability on environments of any size across public cloud,on-premises, and hybrid cloud deployment
NFR -3	**Reliability**	The analysis gives suggestions and steps that can be carried to whole company's attrition problem, as a long-time solution
NFR -4	**Performance**	The performance of the analysis must be solving the problem fully, so that it gives a permanent solution to the problem faced
NFR -5	**Availability**	The dataset is analysed and solution is given to the problem faced and the solution must be available for the full process
NFR -6	**Scalability**	Data is growing at an exponential rate. Keeping up with new data sources across environments creates complexity at an unprecedented scale

5 PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.1.1 User configures credentials for the Watson Natural Language Understanding service and starts the app.

5.1.2 User selects data file to process and load.

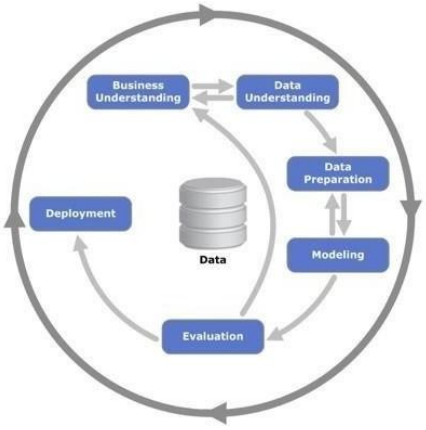
5.1.3 Extracted text is passed to Watson NLU for enrichment.

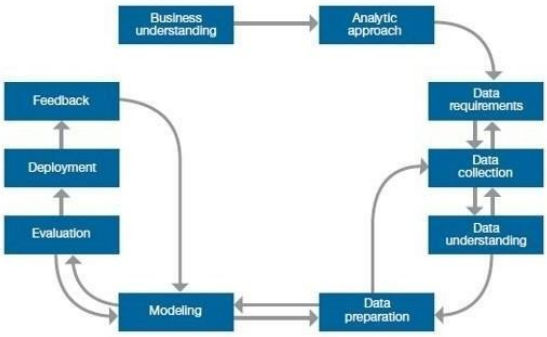
5.1.4 Enriched data is visualized in the UI using the D3.js library

5.1.5 Python cloud is used for coding

5.1.6 The outcomes are analysed and modelled in Python

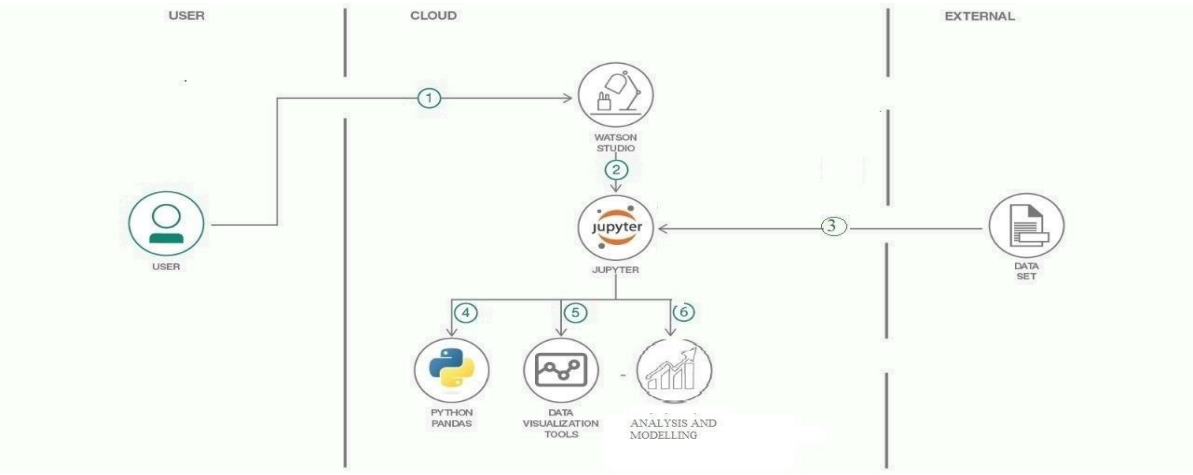
5.1.7 The external data is obtained as solution



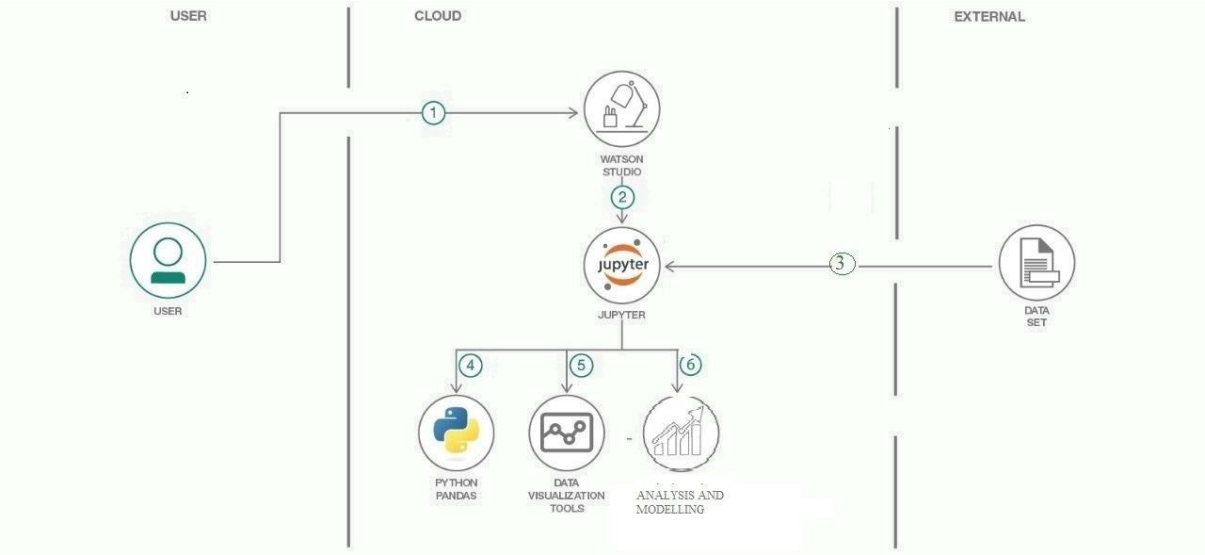


5.2 SOLUTION & TECHNICAL ARCHITECTURE

SOLUTION ARCHITECTURE



TECHNICAL ARCHITECTURE



S.No	Component	Description	Technology
	User Interface Web UI	Web UI is used for the user interaction	HTML, CSS, JavaScript
	Applicatio nLogic-1 IBM Watson Cloud Account	IBM Watson® Studio empowers data scientists, developers and analysts to build, run and manage AI models, and optimize decisions anywhere on IBM Cloud Pak® for Data.	human speech for meaning and syntax.
	Applicatio nLogic-2 IBM Watson Cognos Analytics	IBM® Cognos® Business Intelligence is anintegrated business intelligence suite that provides a wide range of functionality to help you understand your organization's data.	Java. JRE (Java Runtime Environment) to function.
	Applicatio nLogic-3 Python	Google is quite aggressive in AI research.Over many years, Google developed AI framework called **TensorFlow** and a development tool called **Colaboratory**. Today TensorFlow is open-sourced and since 2017, Google made Colaboratory free for public use. Colaboratory is now known as Google Colab or simply **Colab**.	Google Colaboratory (Google Colab) is a free cloud-based framework with a Jupyter notebook environment with free access to CPU/GPU/TPU
1.	Applicatio nLogic-4 Jupyter	The Jupyter Notebook is the original web application for creating and sharing computational documents. It offers a simple, streamlined, document-centric experience.	Jupyter Notebook is built using several open-source libraries, including IPython, ZeroMQ, Tornado, jQuery, Bootstrap, and MathJax.
6.	External API-1Dataset	Kaggle website is used to get the dataset. Kaggle allows users to find and publish data sets, explore and build models in a web-based data-science environment, work with other data scientists and machine learning engineers, and enter competitions to solve data science challenges.	Python and C++ Framework: Keras and PyTorch
7.	Database IBMCloud	With IBM Cloud IaaS, organizations candeploy and access virtualized IT resources -- such as compute power, storage and networking -- over the internet.	IaaS – Infrastructure as a Service

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
	Open-Source Frameworks	The dataset is been obtained from third party Kaggle website. Kaggle website is used to get the dataset. Kaggle allows users to find and publish data sets, explore and build models in a web-based data-science environment, work with other data scientists and machine learning engineers, and enter competitions to solve data science challenges.	Opensource framework - Python and C++ Framework: Keras and PyTorch

	Security Implementations	• Application Logic-1 IBM Watson Cloud Account IBM Watson® Studio empowers data scientists, developers and analysts to build, run and manage AI models, and optimize decisions anywhere on IBM Cloud Pak® for Data. • Application Logic-2 IBM Watson Cognos Analytics IBM® Cognos® Business Intelligence is an integrated business intelligence suite that provides a wide range of functionality to help you understand your organization's data. • Application Logic-3 Python Google is quite aggressive in AI research. Over many years, Google developed AI framework called **TensorFlow** and a development tool called **Colaboratory**. Today TensorFlow is open-sourced and since 2017, Google made Colaboratory free for public use. Colaboratory is now known as Google Colab or simply **Colab** • Application Logic-4 Jupyter The Jupyter Notebook is the original web application for creating and sharing computational documents. It offers a simple, streamlined, document-centric experience.	

			jQuery, Bootstrap, and MathJax.
	Scalable Architecture	The Public cloud infrastructure architecture illustrates the IBM Cloud platform, which can be used to support scalable, secure, and resilient workloads. The infrastructure services include networks, compute, storage, security, and management.	Java. JRE (Java Runtime Environment) to function. C++, JavaScript, Qt framework for its graphical user interface

	Availability	IBM® Data Replication for Availability enables high-speed data replication for business continuity across Db2® databases, Db2 Warehouse, Db2 Warehouse in IBM Integrated Analytics System appliances, and Db2 Warehouse on Cloud. The software enables continuous availability, including disaster recovery by synchronizing transactions over both row- and column-organized tables, whether on the same platform, across the data center, or around the world in an active-active configuration. It offers near real-time asynchronous data replication from a primary database server to one or more standby replicas for workload balancing or shifting workloads during planned outages, while also dramatically reducing the time to recovery for unplanned outages.	C++, JavaScript
	Performance	progressive employers should be mindful of the ethical standards they adhere to while utilizing this information. Collecting and analyzing workforce data without appropriatecommunication and purpose may cause unease and distrust among employees	HTML, CSS, JavaScript human speech for meaning and syntax.

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can registerIBM Cloud Account by entering my email, password, and confirming my password. As a user, I will receive confirmation email once I have registered for the application	I can access my account / dashboard I can receive confirmation email & click confirm	Low	Sprint-1

Customer (Mobile user)	Registration	USN-2	As a user, I can register IBM Cognos Analytics -by entering my email, password, and confirming my password As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm.I can access my account / dashboard	High	Sprint-2
Customer (Mobile user)	Registration	USN-3	Jupyter is signed in through google collabs	I can receive confirmation email & click confirm.I can access my account / dashboard	High	Sprint-2
Customer Third party	Login	USN-4	As a user, I can register for the application through Kaggle	I can register & access the dashboard with Gmail Login.I can receive confirmation email & click confirm	Medium	Sprint-3
Customer Cloud	Login and Register	USN-5	As a user, I can register for the python through Gmail	I can register & access the dashboard with Gmail Login. I can receive confirmation email & click confirm	High	Sprint-4

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	To model the probability of attrition using logistic regression	USN-1	As a user, I canregister for theapplication by entering my email, through google collabs	2	High	1) Bheulah G.L. 2) Ashwini A. 3) Sameera Banu N. 4) Shaheenah M.
Sprint-1	Business understanding, importing packages and understanding the data	USN-2	As a user, I canregister for theapplication by entering my email, through google collabs	1	High	1) Bheulah G.L. 2) Ashwini A. 3) Sameera Banu N. 4) Shaheenah M.
Sprint-2	Data Understanding & Data preparation	USN-3	As a user, I canregister for theapplication by entering my email, through google collabs	2	Low	1) Bheulah G.L. 2) Ashwini A. 3) Sameera Banu N. 4) Shaheenah M.

Sprint-3	Data Understanding And Data preparation	USN-4	As a user, I canregister for theapplication by entering my email, through google collabs	2	Medium	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
Sprint-4	EDA, Model Building and Model Evaluation	USN-5	As a user, I canregister for theapplication by entering my email, through google collabs	1	High	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.

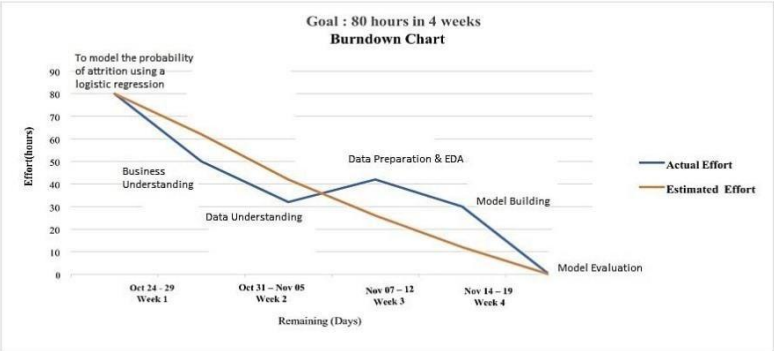
Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed(as on Planned End Date)	Sprint Release Date (Actual)
Sprint1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

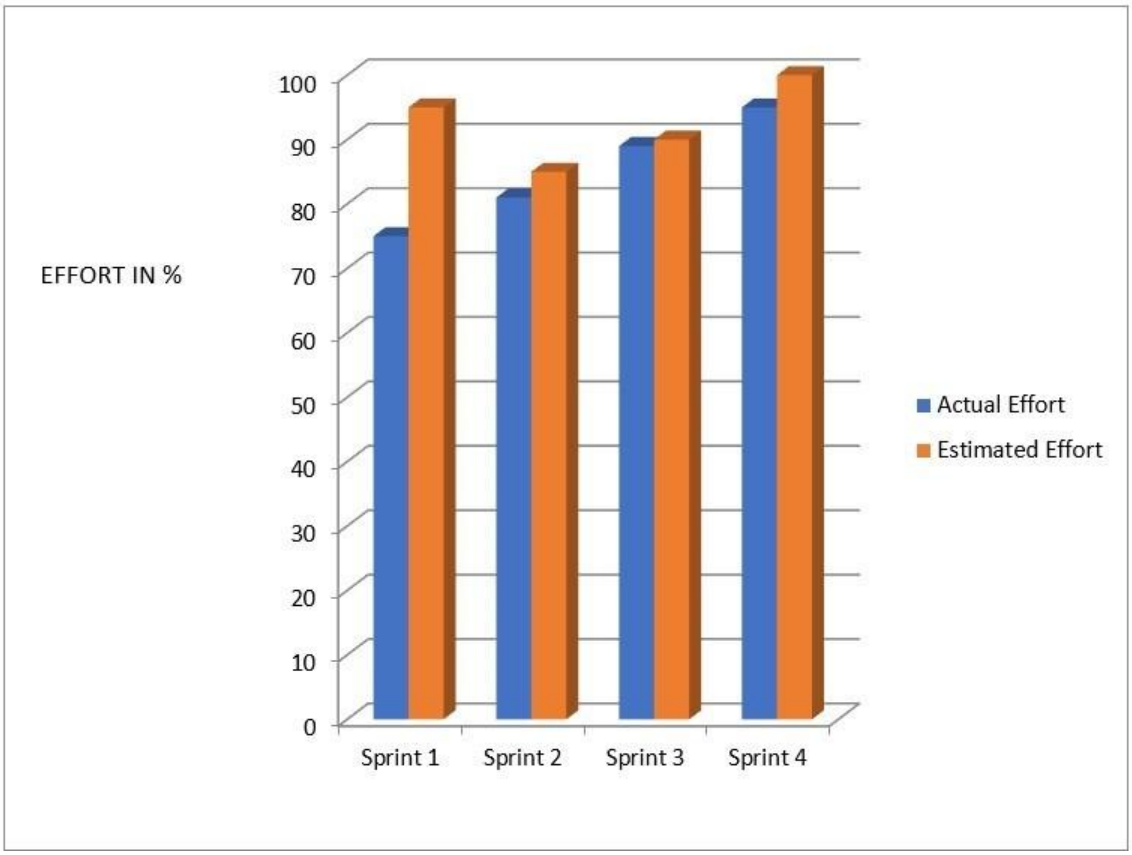
Velocity:

AV = sprint duration / velocity = 20/10 = 2

BURNDOWN CHART:



VELOCITY CHART:

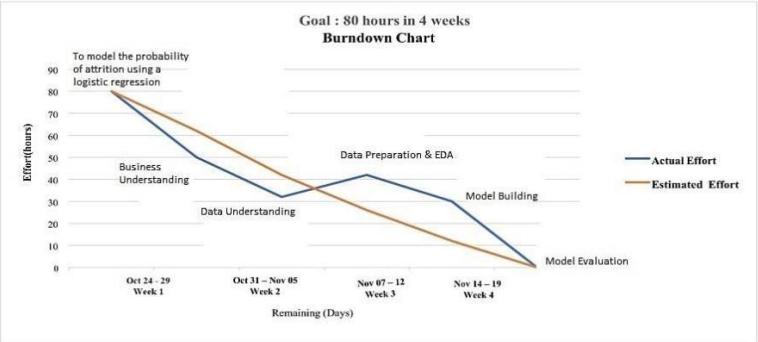


6.2 SPRINT DELIVERY SCHEDULE

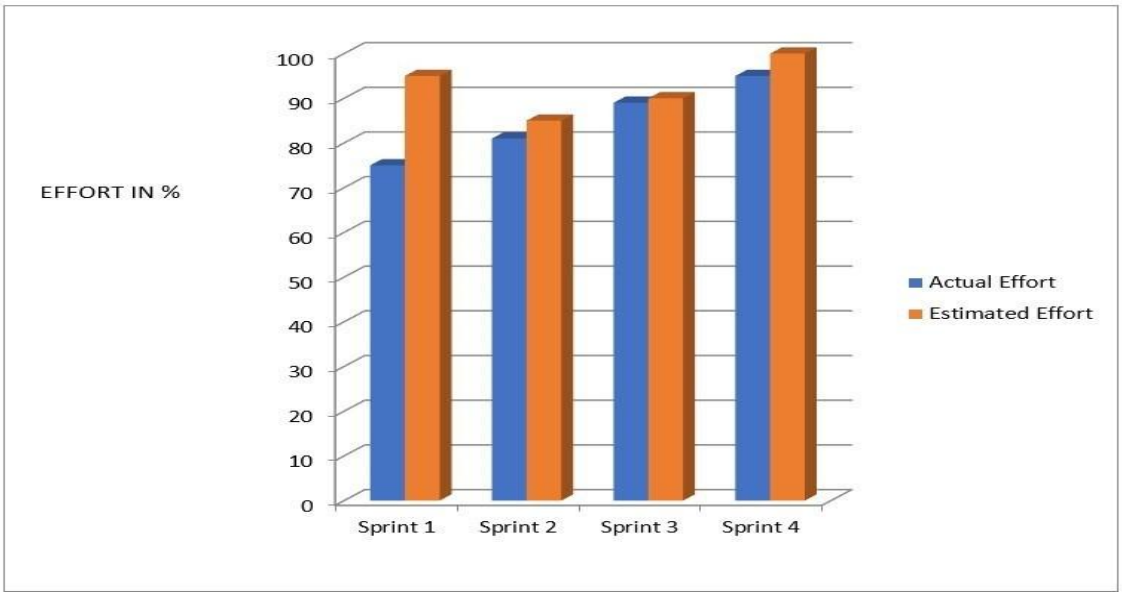
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 REPORTS FROM JIRA

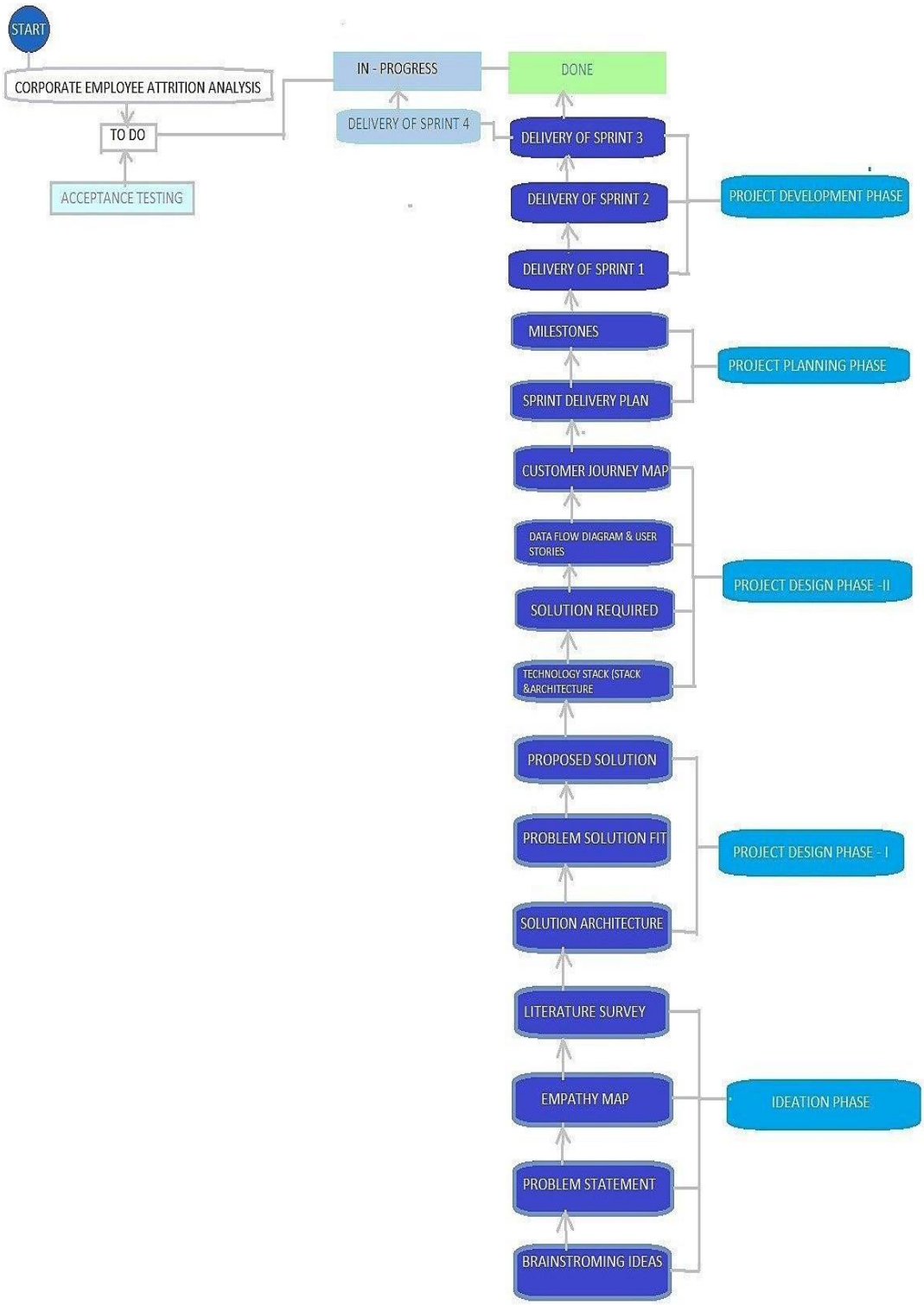
BURNDOWN CHART:



VELOCITY CHART:



WORK REPORT:


START
CORPORATE EMPLOYEE ATTRITION ANALYSIS
TO DO
ACCEPTANCE TESTING
IN - PROGRESS
DELIVERY OF SPRINT 4
DONE
DELIVERY OF SPRINT 3
DELIVERY OF SPRINT 2
DELIVERY OF SPRINT 1
PROJECT DEVELOPMENT PHASE
MILESTONES
SPRINT DELIVERY PLAN
PROJECT PLANNING PHASE
CUSTOMER JOURNEY MAP
DATA FLOW DIAGRAM & USER STORIES
SOLUTION REQUIRED
TECHNOLOGY STACK (STACK &ARCHITECTURE
PROJECT DESIGN PHASE -II
PROPOSED SOLUTION
PROBLEM SOLUTION FIT
SOLUTION ARCHITECTURE
PROJECT DESIGN PHASE - I
LITERATURE SURVEY
EMPATHY MAP
PROBLEM STATEMENT
BRAINSTROMING IDEAS
IDEATION PHASE

7 CODING & SOLUTIONING

7.1 Feature 1

DATASET :

- Employee Attrition Analysis (Logistic Regression Model)Employee Attrition Analysis (Logistic Regression Model)

https://www.kaggle.com/vjchoudhary7/hr-analytics-case-study

DATA UNDERSTANDING:

The data received for the analysis can be divided into 4 broad categories -

•General Data – General data, acquired from HR

•Employee Survey Data – Data collected from yearly employee survey

•Manager Survey Data – Data collected from yearly manager survey

•Biometric Data – Daily in and out times for each employee, collected using biometric attendance machines

General Data
Age
Attrition (Yes/No)
Department
Education Field

Manager Survey Data
Job Involvement
Performance Rating

Employee Survey Data
Environment Satisfaction
Job Satisfaction
Work Life Balance

Biometric Data
In Time
Out Time

UNDERSTANDING THE DATASET:

Let us try to understand each field of the data (general_data.csv)

Below are the values each column has. The column names are pretty self-explanatory.

1. AGE Numerical Value
2. ATTRITION Employee leaving the company (0=no, 1=yes)
3. BUSINESS TRAVEL (1=No Travel, 2=Travel Frequently, 3=Travel Rarely)
4. DEPARTMENT (1=HR, 2=R&D, 3=Sales)

5. DISTANCE FROM HOME Numerical Value - THE DISTANCE FROM WORK TOHOME
6. EDUCATION Numerical Value. (1 'Below College' 2 'College' 3 'Bachelor' 4'Master' 5 'Doctor')
7. EDUCATION FIELD (1=HR, 2=LIFE SCIENCES, 3=MARKETING, 4=MEDICALSCIENCES, 5=OTHERS, 6= TECHNICAL)
8. EMPLOYEE COUNT Numerical Value
9. EMPLOYEE ID Numerical Value
10. GENDER (1=FEMALE, 2=MALE)
11. JOB LEVEL Numerical Value
12. JOB ROLE (1=HR REP, 2=HR, 3=LAB TECHNICIAN, 4=MANAGER, 5= MANAGING DIRECTOR, 6= RESEARCH DIRECTOR, 7= RESEARCH SCIENTIST,8=SALES EXECUTIVE, 9= SALES REPRESENTATIVE)
13. MARITAL STATUS (1=DIVORCED, 2=MARRIED, 3=SINGLE)
14. MONTHLY INCOME Numerical Value - MONTHLY SALARY
15. NUMCOMPANIES WORKED Numerical Value - NO. OF COMPANIES WORKEDAT
16. OVER 18 (1=YES, 2=NO)
17. PERCENT SALARY HIKE Numerical Value - PERCENTAGE INCREASE IN SALARY
18. STANDARD HOURS Numerical Value - STANDARD HOURS
19. STOCK OPTIONS LEVEL Numerical Value - STOCK OPTIONS (Higher thenumber, the more stock option an employee has)
20. TOTAL WORKING YEARS Numerical Value - TOTAL YEARS WORKED
21. TRAINING TIMES LAST YEAR Numerical Value - HOURS SPENT TRAINING
22. YEARS AT COMPANY Numerical Value - TOTAL NUMBER OF YEARS AT THECOMPANY
23. YEARS SINCE LAST PROMOTION Numerical Value - LAST PROMOTION
24. YEARS WITH CURRENT MANAGER Numerical Value - YEARS SPENT WITHCURRENT MANAGER

b. Let us try to understand about each field of the data (employee_survey_data.csv)

1. Employee ID
2. Environment Satisfaction (1 'Low' 2 'Medium' 3 'High' 4 'Very High')
3. Job Satisfaction (1 'Low' 2 'Medium' 3 'High' 4 'Very High')
4. Work Life Balance (1 'Bad', 2 'Good', 3 'Better', 4 'Best')

c. Let us try to understand about each field of the data (manager_survey_data.csv)

1. Employee ID
2. Job Involvement (1 'Low' 2 'Medium' 3 'High' 4 'Very High')
3. Performance Rating (1 'Low', 2 'Good', 3 'Excellent', 4 'Outstanding')

SOLUTION REQUIRED:

•To model the probability of attrition using a logistic regression
•Business Understanding
•Data Understanding – sources of the data, meaning of the data
•Data preparation & EDA
•Model Building
•Model Evaluation
•Data Visualization charts
•Dashboard Creation

METHODOLOGY USED:

- Predictive modelling of attrition
- Recommending ways for company XYZ to decrease its level of attrition

LIBRARIES USED FOR THIS CODE:

ibm corporate employee attrition analysis.ipynb

File Edit View Insert Runtime Tools Help Last saved at 8:18 PM

Comment Share

+ Code + Text

Connect Editing

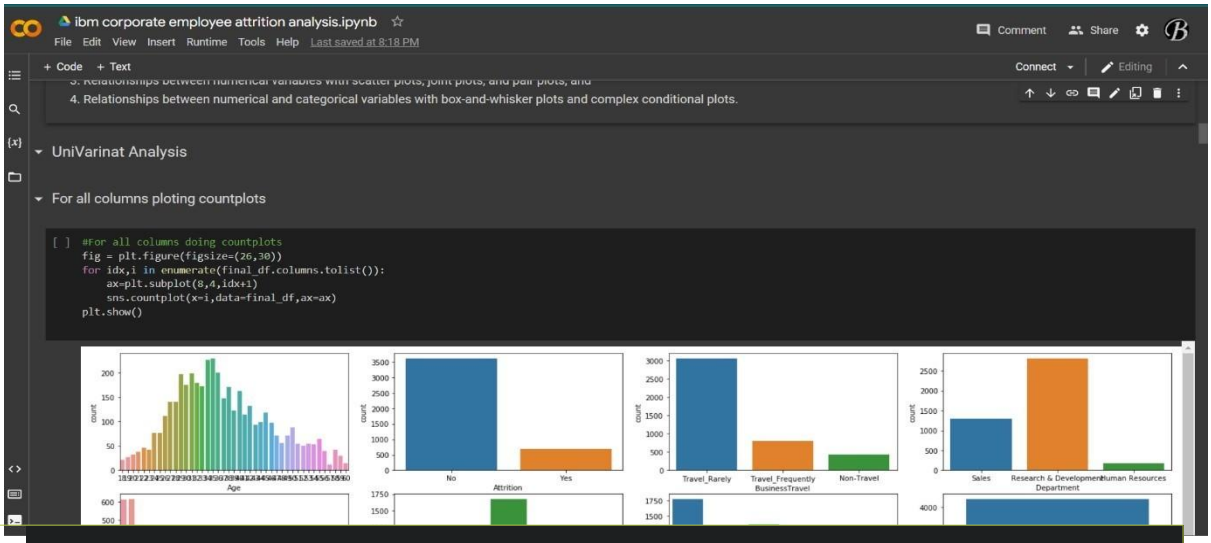
Libraries used for this Code

```
[ ] import warnings
    warnings.filterwarnings("ignore")
    import re
    import os
    import datetime as dt

    import numpy as np
    import pandas as pd
    import matplotlib.pyplot as plt
    import seaborn as sns
    import csv

    from sklearn.feature_extraction.text import CountVectorizer
    from sklearn.linear_model import SGDClassifier
    from sklearn import metrics
    from sklearn.metrics import f1_score,precision_score,recall_score
    from sklearn import svm
    from sklearn.linear_model import LogisticRegression
    from  sklearn.svm import SVC
    from sklearn.metrics import log_loss, make_scorer
    import math
    from sklearn.metrics import roc_auc_score
    from sklearn.metrics import auc
    from sklearn.metrics import accuracy_score
    from sklearn.metrics import confusion_matrix
    from sklearn.metrics import classification_report
    from sklearn.metrics import roc_curve
    from sklearn.metrics.classification import accuracy_score, log_loss
```

UNIVARIANT ANALYSIS

FOR ALL COLUMNS PLOTTING COUNT

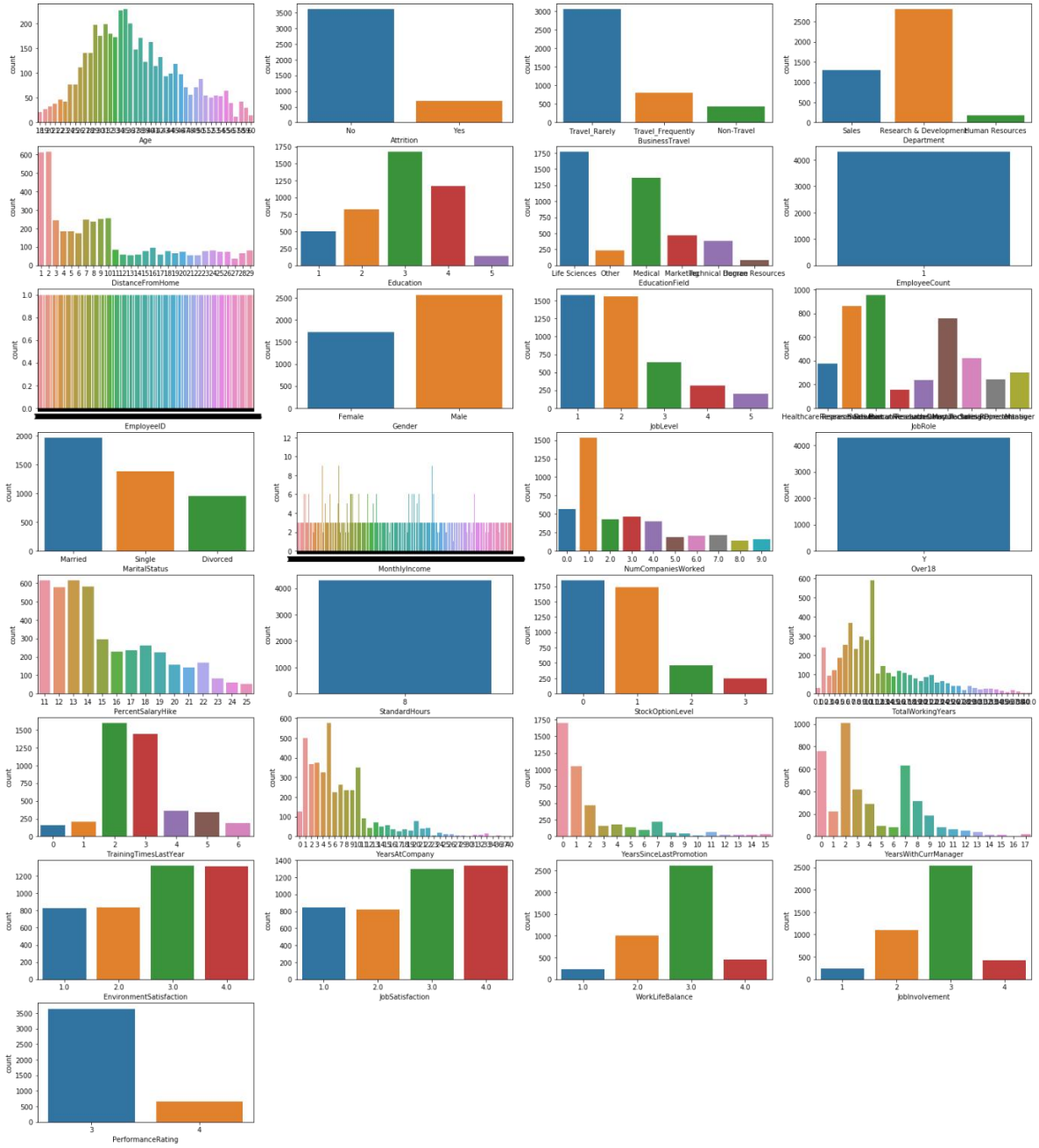
PLOTSCODING:




```
#For all columns doing countplots
```

```
fig = plt.figure(figsize=(26,30))  for idx,i in
enumerate(final_df.columns.tolist()):
ax=plt.subplot(8,4,idx+1)
   sns.countplot(x=i,data=final_df,ax=ax)plt.show()
```

OUTPUT:


count
Age
No
Yes
Attrition
Travel_Rarely
Travel_Frequently
Non-Travel
BusinessTravel
Sales
Research & Development
Human Resources
Department
DistanceFromHome
Education
Life Sciences
Other
Medical
Marketing
Technical Degree
Human Resources
EducationField
EmployeeCount
EmployeeID
Female
Male
Gender
JobLevel
Healthcare Representative
Research Director
Manager
Manufacturing Director
Research Scientist
Laboratory Technician
Sales Executive
Sales Representative
Human Resources
JobRole
Married
Single
Divorced
MaritalStatus
MonthlyIncome
NumCompaniesWorked
Y
Over18
PercentSalaryHike
StandardHours
StockOptionLevel
TotalWorkingYears
TrainingTimesLastYear
YearsAtCompany
YearsSinceLastPromotion
YearsWithCurrManager
EnvironmentSatisfaction
JobSatisfaction
WorkLifeBalance
JobInvolvement
PerformanceRating

7.3 DATABASE SCHEMA

DATA VISUALIZATION CHARTS AND DASHBOARD CREATION

Using the given dataset, we need to create various graphs and charts to highlight the insights and visualizations. For the given problem statment, try to build the following visualizations that suit the solution requirements.

- Employee Attrition by Age
- Attrition by Business Travel
- Attrition by Department, Job Role, Education Level and Marital Status
- Attrition by Salary Hike Percent
- Attrition by No. of Companies Worked
- Attrition by Income Groups
- Attrition by Work Experience Groups
- Dashboard of Attrition of Employees based on Employment details

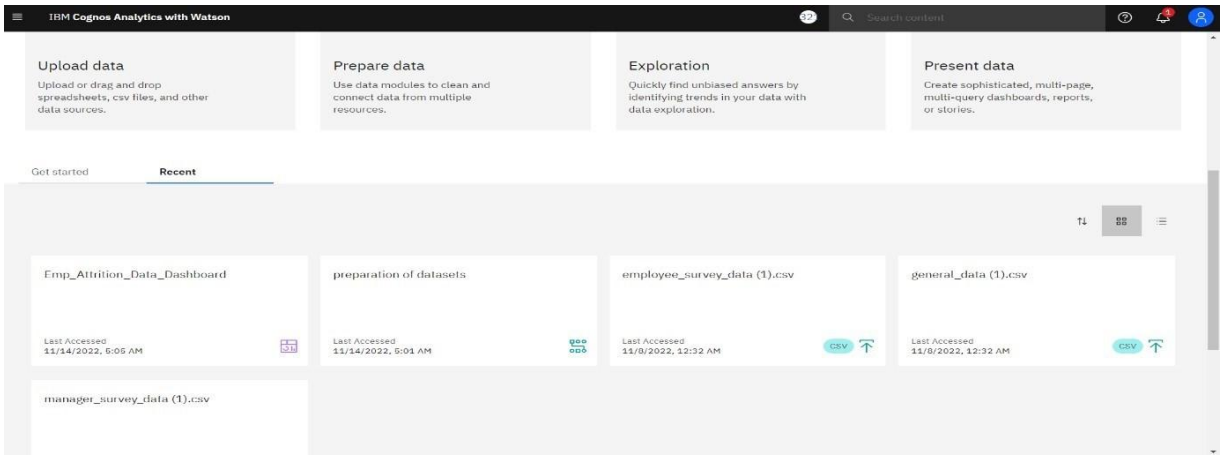
IBM COGNOS ANALYTICS

To create data visualization charts and dashboard we need to login into IBM Cognos analytics. IBM® Cognos® Analytics integrates reporting, modeling, analysis, dashboards, stories, and event management so that you can understand your organization data, and make effective business decisions. Thistool is used to give better understanding about the dataset.

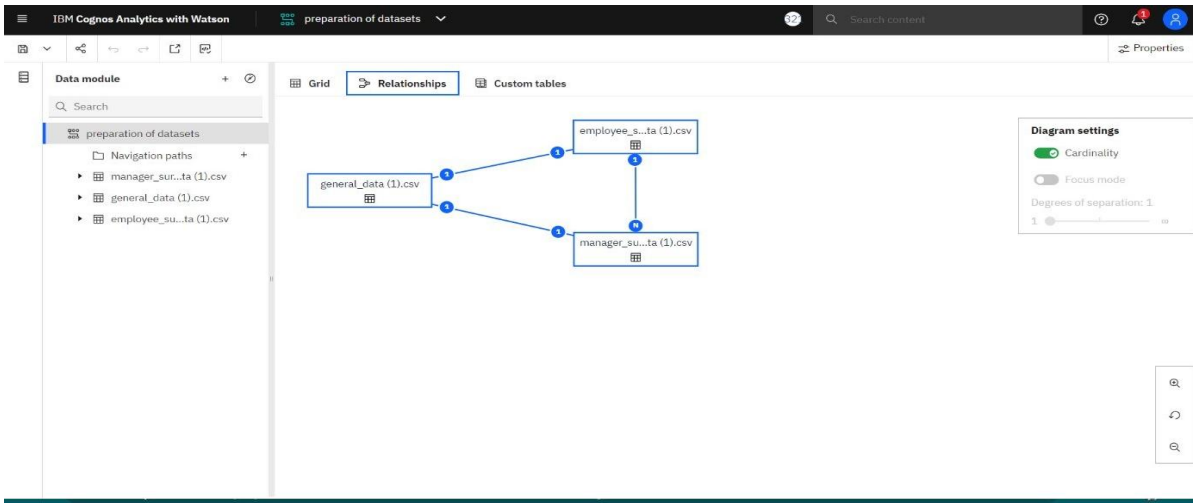
STEPS TO CREATE VISUALIZATION CHARTS AND DASHBOARD CREATION

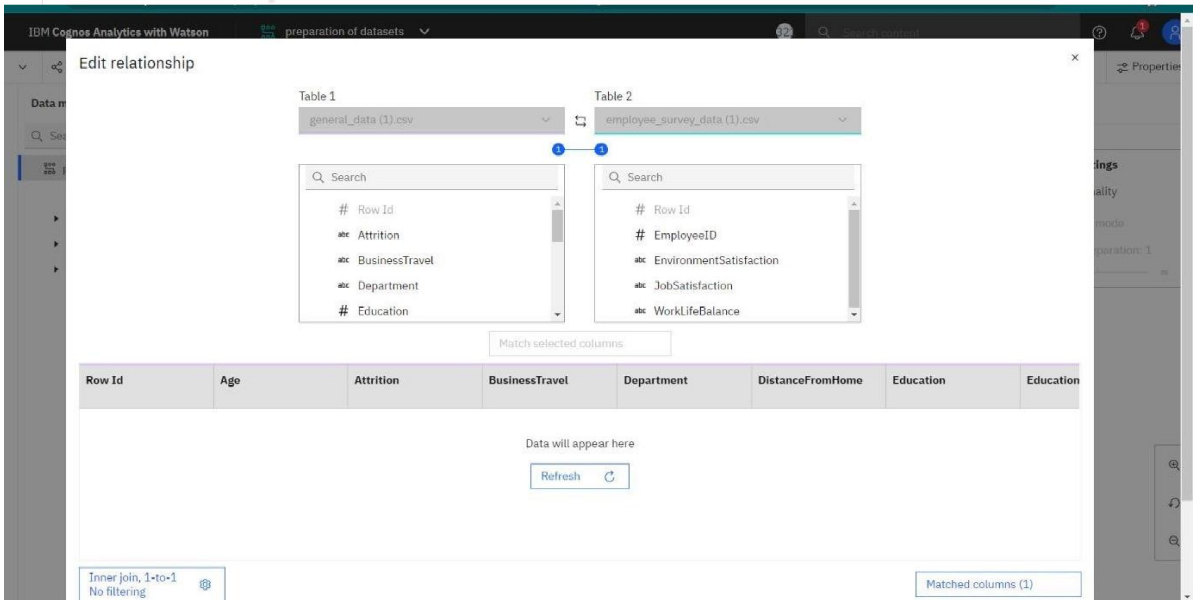
- Uploading of data
- Preparing the data
- Exploration of data
- Creation of Visualization Charts
- Dashboard creation

LOADING THE DATASET :



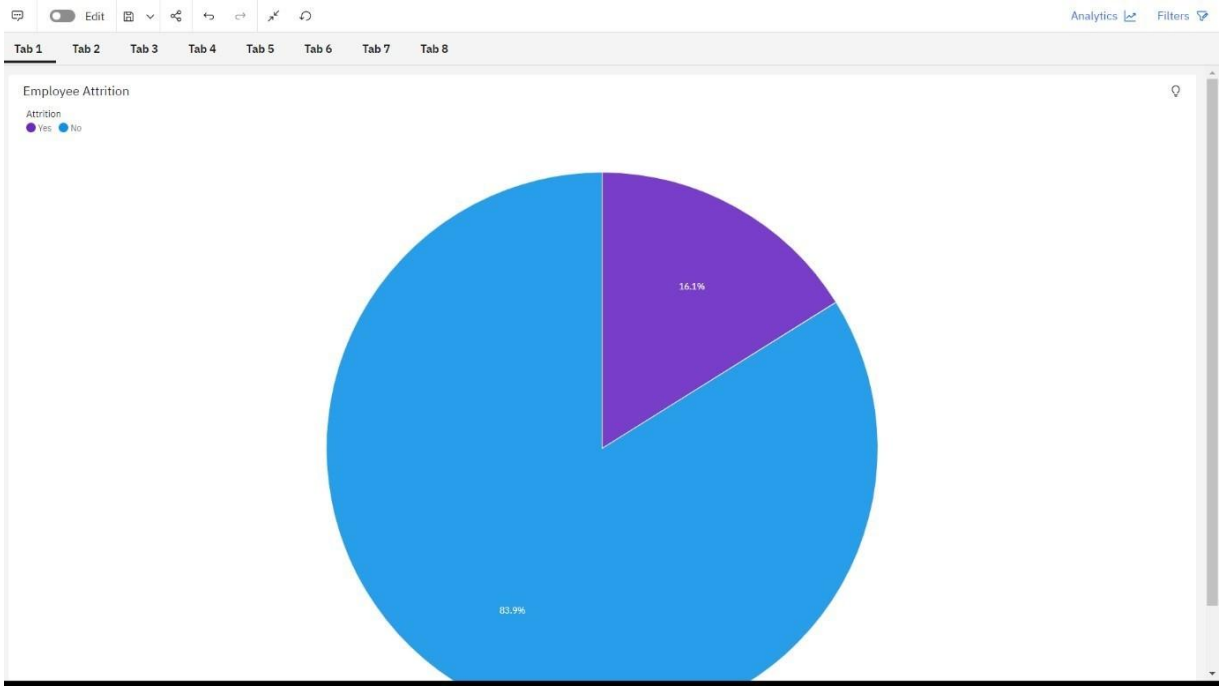
PREPARING THE DATA & EXPLORATION OF DATA





CREATION OF VISUALIZATION CHARTS

- EMPLOYEE ATTRITION STATUS:



- INFERENCES :

We can understand from the above pie chart that 16.1% of people are willing to leave and 83.3% say no to it

- ATTRITION BY BUSINESS TRAVEL

FINDING OF THIS PROJECT:

A total of 24 variables, collected from 4 sources were used to predict the probability of an employee leaving the company in the next year, using a logistic regression model

- Logistic Regression Model* is able to correctly identify 77% ofemployees that were likely to churn
- It is also able to identify employees that are not likely to churn, with 77% accuracy

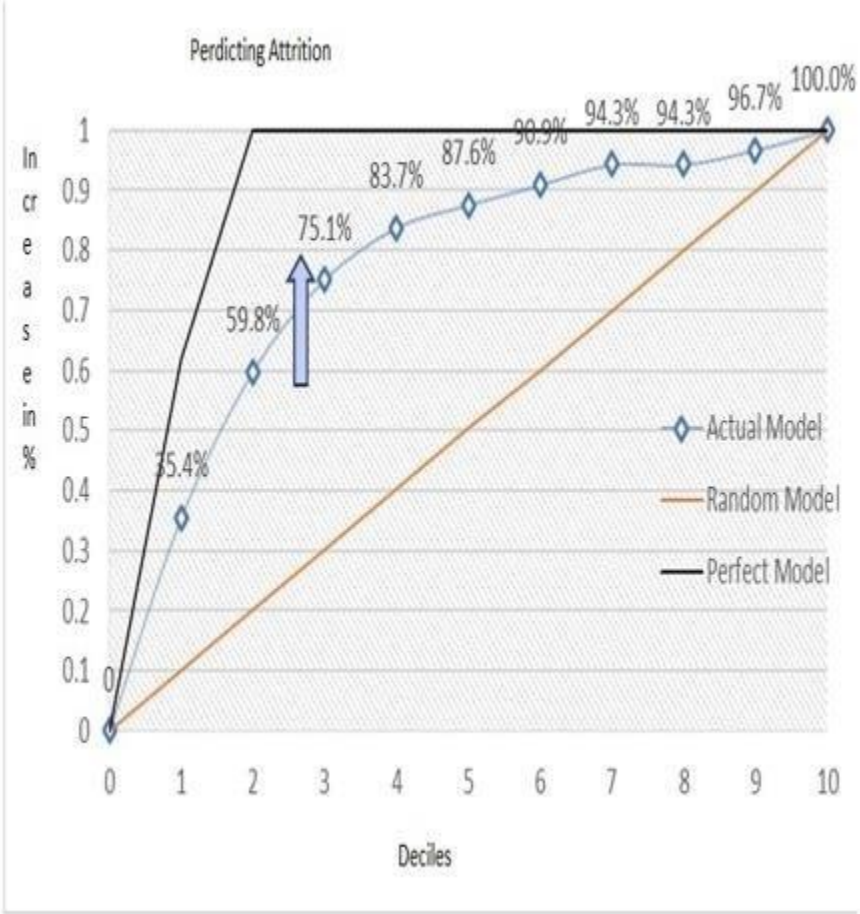
➤ KS Statistic falls in 3rd decile (top 30%)

- Hence, it would be beneficial to target 30% of your employees most likely to leave, and work on making them stay.
- Targeting fewer employees (top 20% or top 10%) will not identifyenough employees likely to leave

Targeting more employees (top 40% or top 50%) will be inefficient

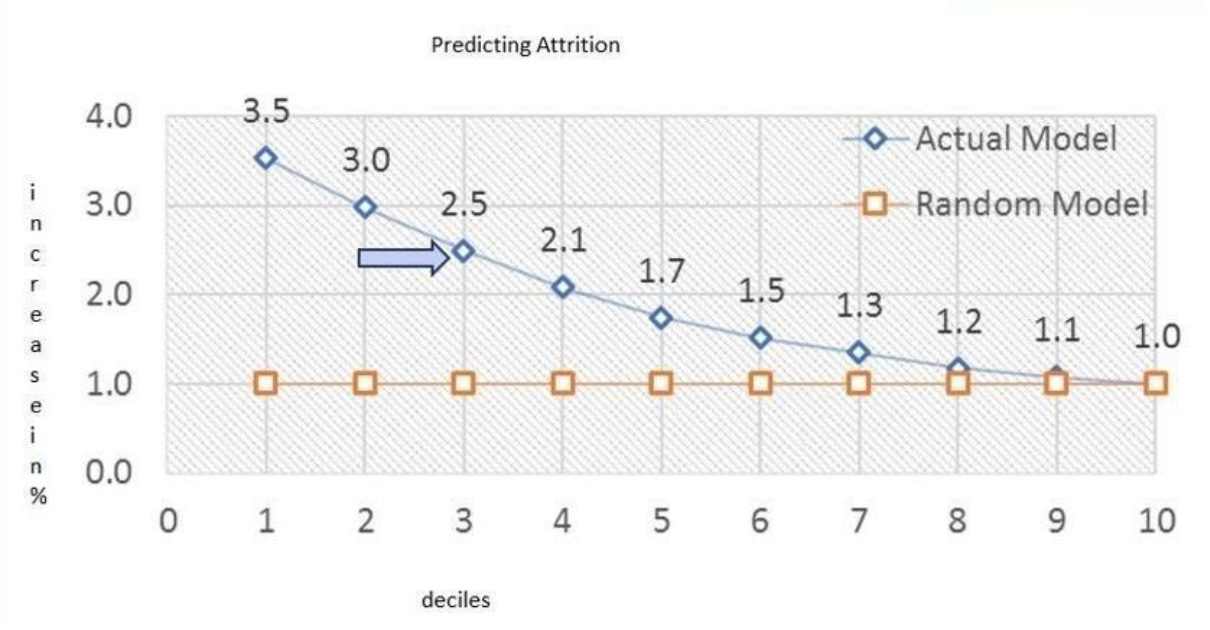
➤ Predicting Attrition – Model is able to capture 75% of employees likely to leave

- Model is able to identify 75% of the employees likely to leave in the first 3 deciles



➢ Predicting Attrition – Model performs 2.5 times better than a random reach out

- Using the model offers a "lift" of 2.5 for the 3rd decile



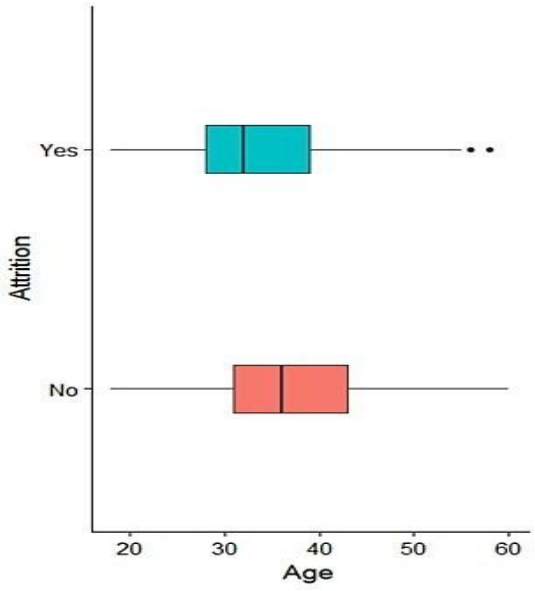
RECOMMENDATIONS – WHAT FACTORS MAKE EMPLOYEES STAY/LEAVE? (1/4)

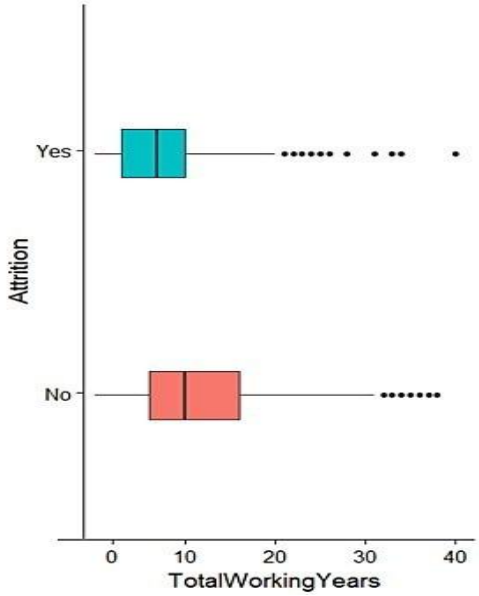
EXPERIENCE

- Employees that have worked for a total of 7 years or lessare more likely to leave*
- Employees that have worked for a total of 10 years or moreare more likely to stay*

AGE

- Employees aged 36 years and above are more likely to stay*
- Employees aged 32 years and below are more likely to leave*





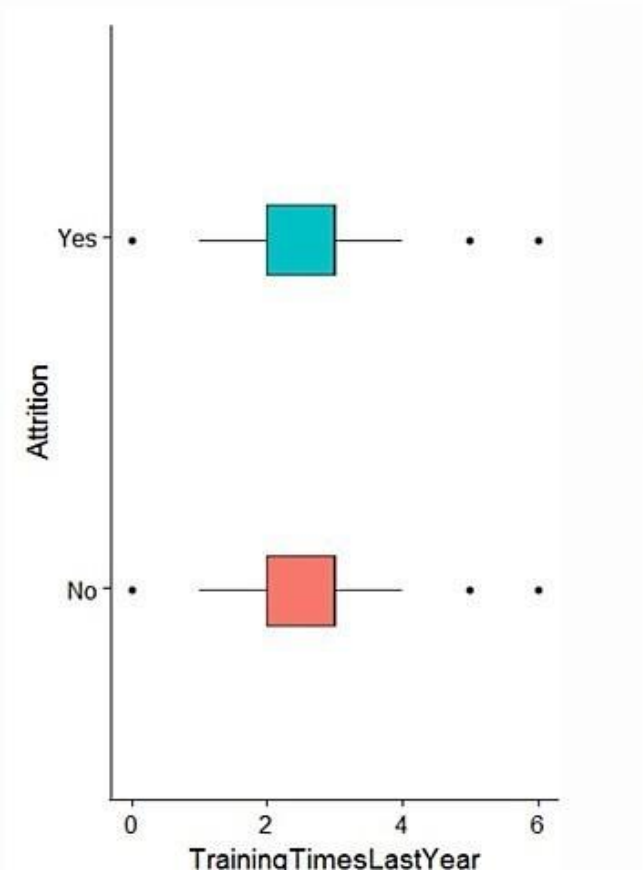
RECOMMENDATIONS – WHAT FACTORS MAKE EMPLOYEES STAY/LEAVE? (2/4)

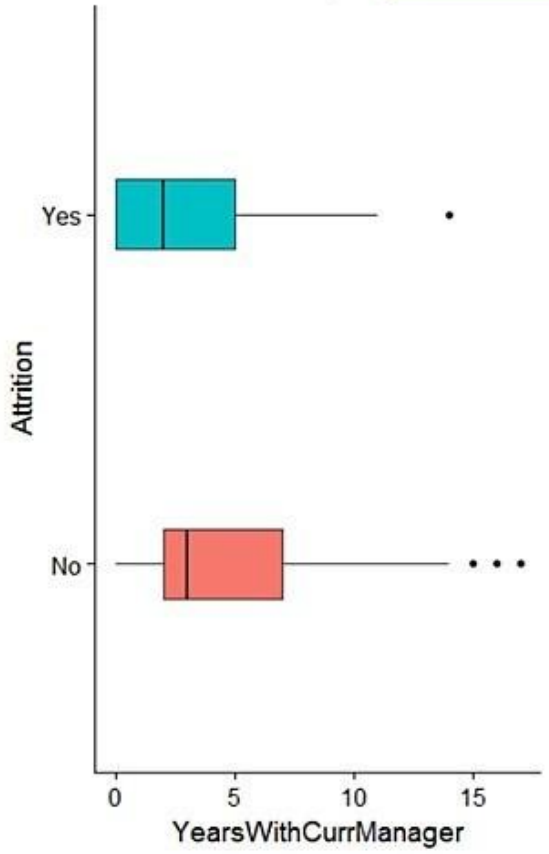
TRAINING

- Employees that got 3 or more training sessions last year are more likely to stay*
- Employees that got 2 or fewer training sessions last year are more likely to leave*

YEARS WITH CURRENT MANAGER

- Employees that have spent 3 years or more under the same manager are more likely to stay*
- Employees that have spent 2 years or less under the same manager are more likely to leave*





RECOMMENDATIONS – WHAT FACTORS MAKE EMPLOYEES STAY/LEAVE? (3/4)

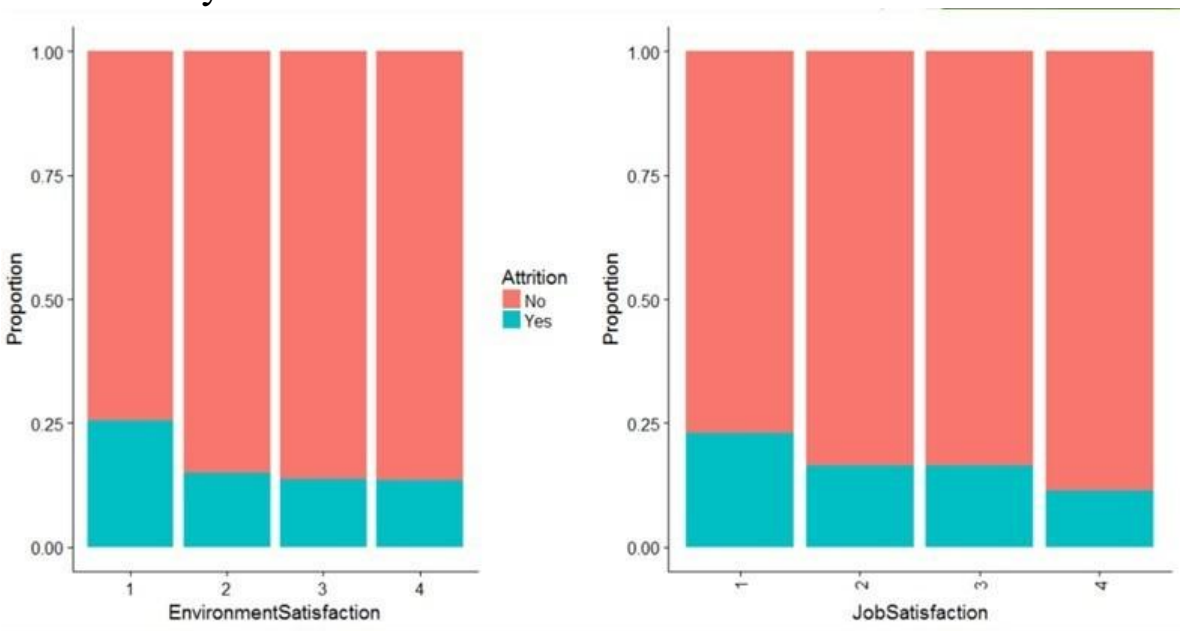
› JOB SATISFACTION

- Employees that have medium, high or very high levels of job satisfaction, are more likely to stay*
- Employees that have low levels of job satisfaction, are more likely to leave*

› ENVIRONMENT SATISFACTION

- Employees that have medium, high or very high levels of environment satisfaction, are more likely to stay*

•Employees that have low levels of environment satisfaction, are more likely to leave*



RECOMMENDATIONS – WHAT FACTORS MAKE EMPLOYEES STAY/LEAVE? (4/4)

AVERAGE WORK HOURS

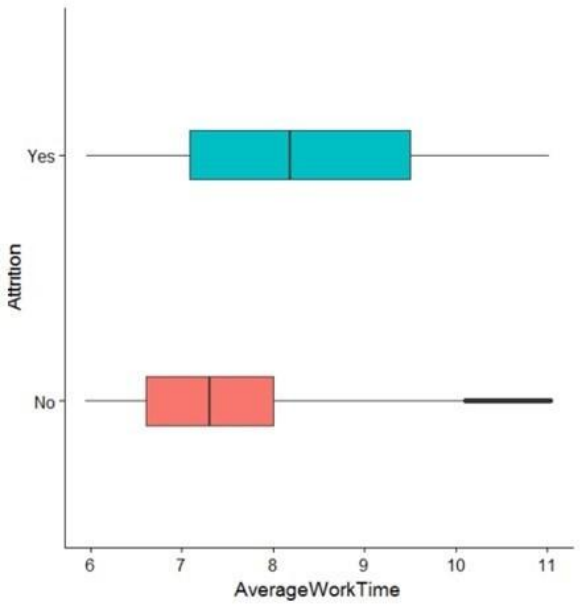
• Employees that, on average work for 7.3 hours or less, are more likely to stay*

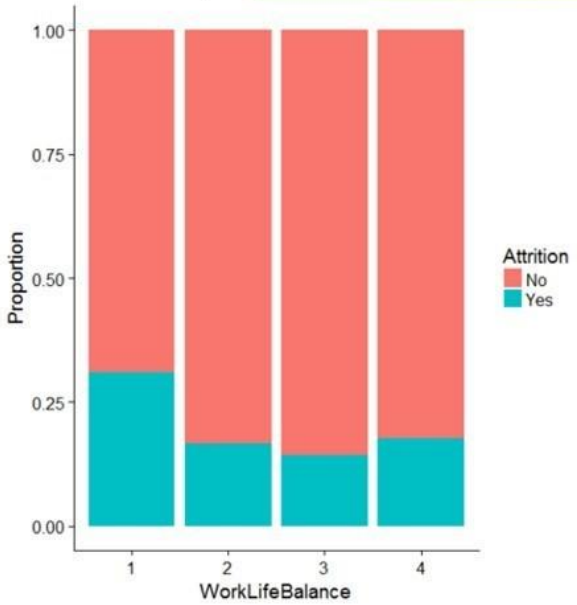
•Employees that, on average work for 8.2 hours or more, are more likely to leave*

WORK LIFE BALANCE

• Employees that rated their work life balance as good, better or best, are more likely to stay**

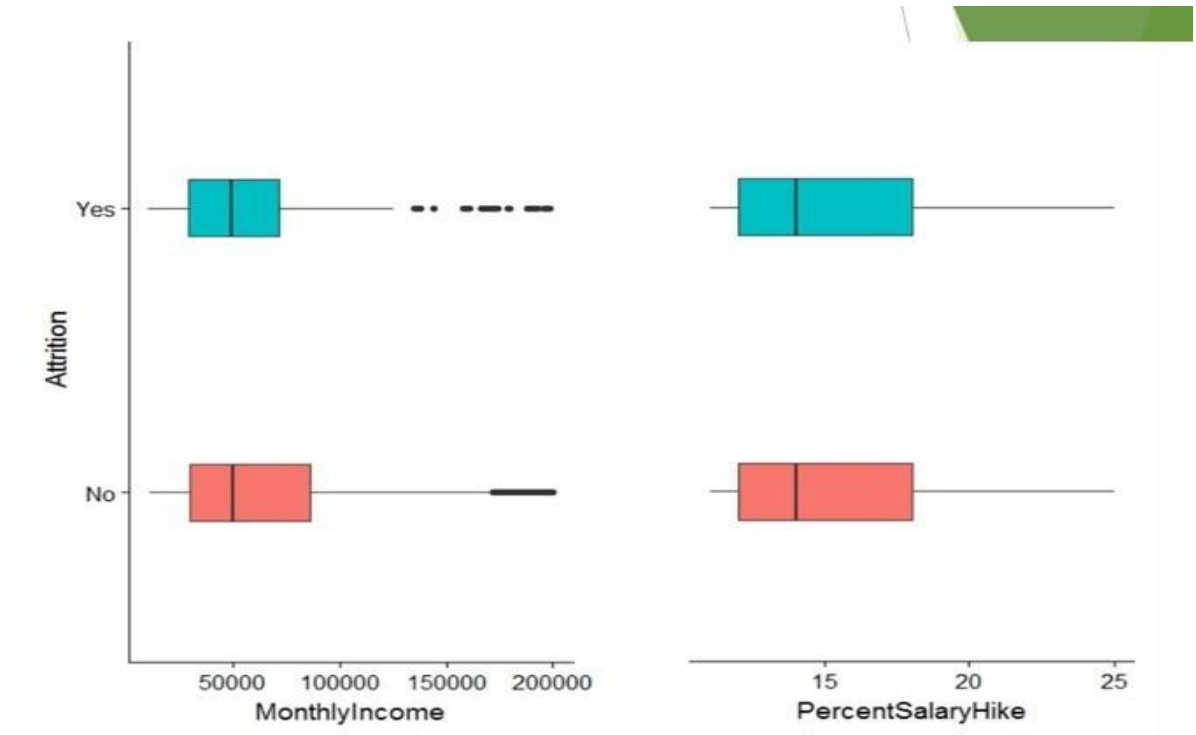
•Employees that rated their work life balance as bad, are more likely to leave**





▯ RECOMMENDATIONS – FACTORS THAT SURPRISINGLY DON'T AFFECT ATTRITION

◇ ▸ Monthly Income and Percent Salary Hike do not affect attrition*



RECOMMENDATIONS

◆ CURRENT EMPLOYEES:

- Work life balance should be improved
- Work environment should be improved
- The manager of an employee should not be changed very often
- Employees should be provided relevant training regularly, especially for its younger employees

◆ FUTURE EMPLOYEES (CHANGES IN HIRING PROCESS):

- The company should follow either one of the strategies given below –
  - Hire older people with decent work experience
  - Hire young people and train them appropriately
- It could also opt for a combination of the two

8.TESTING

8.1 Test Cases

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
Hypothesis Condition	Functional	General_data.c	Hypothesis condition has two parameter 0 or 1	Cleaning and preparation of data	1.To check and prepare the data 2.To write python codes for Hypothesis condition	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	Hypothesis value for each parameter either 0 or 1	Working as expected	Pass	Steps are clear and coding is right	Output of the test is displayed as result	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
Train Test Split	Functional	General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	Each parameter of general data survey is made as parameter for test split	Cleaning and preparation of data	1.To test each data for test split 2.We need to write python code for each test split	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	The should be passed as package	Working as expected	pass	Steps are clear and coding is written right	The test case is passed	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
Hyper Parameter Testing	Functional	General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	checking the condition for developing model	Cleaning and preparation of data	1.To prepare and clean the data and 2.To write python codes for each parameters	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	The should be passed as package	Working as expected	pass	Steps are clear and coding is written right	The test case is passed	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
Confusion Matrix	Functional	General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	Overall necessary prediction can be made	Cleaning and preparation of data	1.To prepare the data 2. To write python code for each parameter	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	The parameter required for modelling can be identified and result is seen as heat plot	Working as expected	pass	Steps are clear and coding is written right	Output is seen as Heat plot	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
EDA	Functional	General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	Development of Model	Cleaning and preparation of data	1.To find the parameter required for modelling 2. To write python code	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	The case is passed and the result is seen as bar graph	Working as expected	pass	Steps are clear and coding is written right	The output is seen as bar graph	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
Logistic Regression	Functional	General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	Outcome of the Model	Cleaning and preparation of data	1. To find the required data for Regression Modelling 2. To write python coding	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	The case is passed and the result is seen as bar graph	Working as expected	pass	Steps are clear and coding is written right	The output is seen as bar graph	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.
SVM Model	Functional	Survey_Data.c	Modelling test	Cleaning and preparation of data	1. From the Regression Modelling, the resulting parameter will be used for SVM modelling. 2.To write python coding	https://www.kaggle.com/datasets/vjchoudhary7/hr-analytics-case-study General_data.csv, Employee_Survey_Data.csv, Manager_Survey_data.csv	The case is passed and the result is seen	Working as expected	pass	Steps are clear and coding is written right	The output is seen as bar graph	nul	1)Bheulah G.L. 2)Ashwini A. 3)Sameera Banu N. 4)Shaheenah M.

8.2 USER ACCEPTANCE TESTING

UAT Execution & Report Submission

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

1. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, andhow they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Model	1	2	1	0	3
Duplicate	1	0	0	0	1
External	2	0	0	1	3
Fixed	7	2	3	0	12
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	1	0	0	1
Totals	11	5	6	2	23

1.1 Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fai l	Pass
Hypothesis Condition	2	0	0	2
Train Test Split	5	2	0	3
Hyper Tuning Parameter Test	4	0	0	4
Confusion Matrix	1	0	0	1
Logistic Regression	1	0		1
Final Report Output	6	2	0	4
SVM Model	1	0	0	1

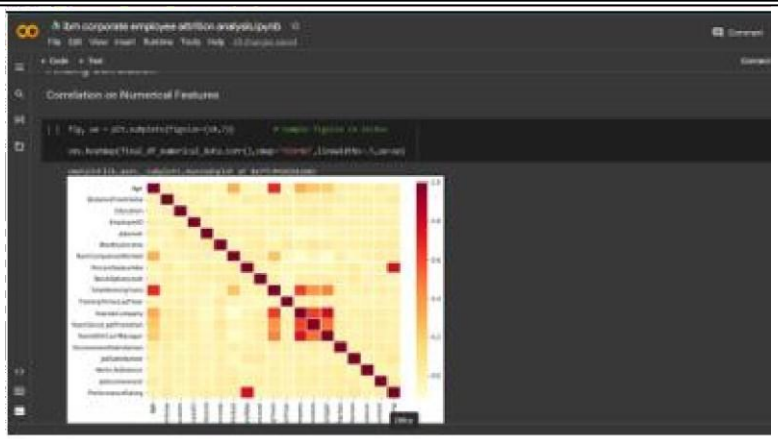
9. RESULTS

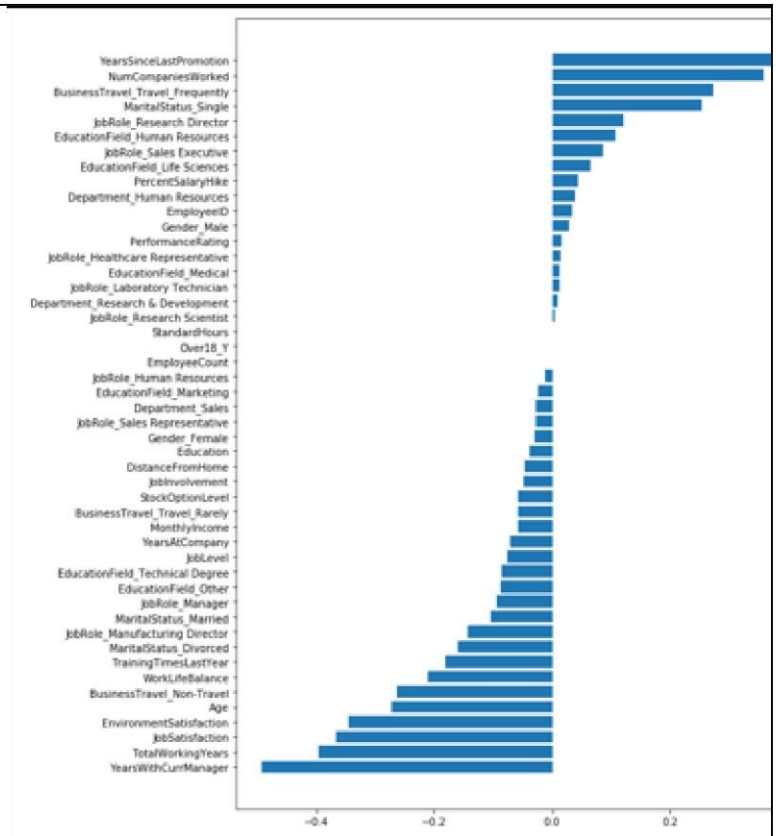
9.1 PERFORMANCE METRICS

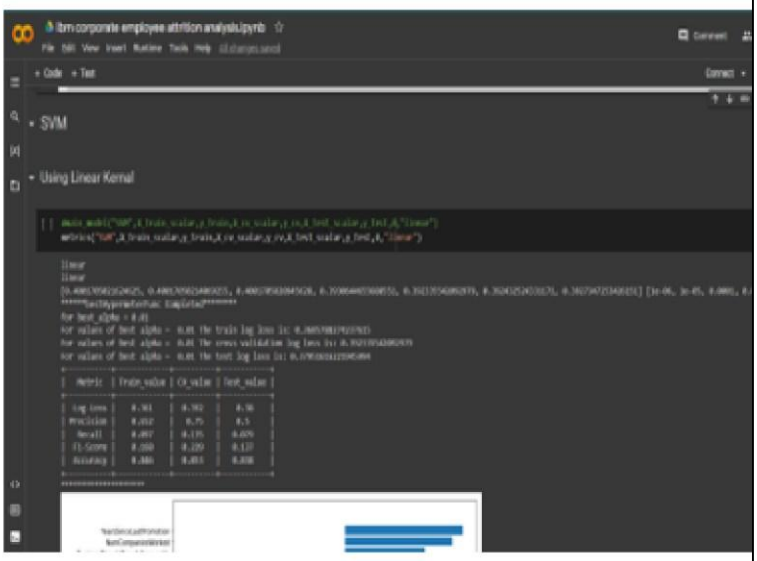
Model Performance Testing:

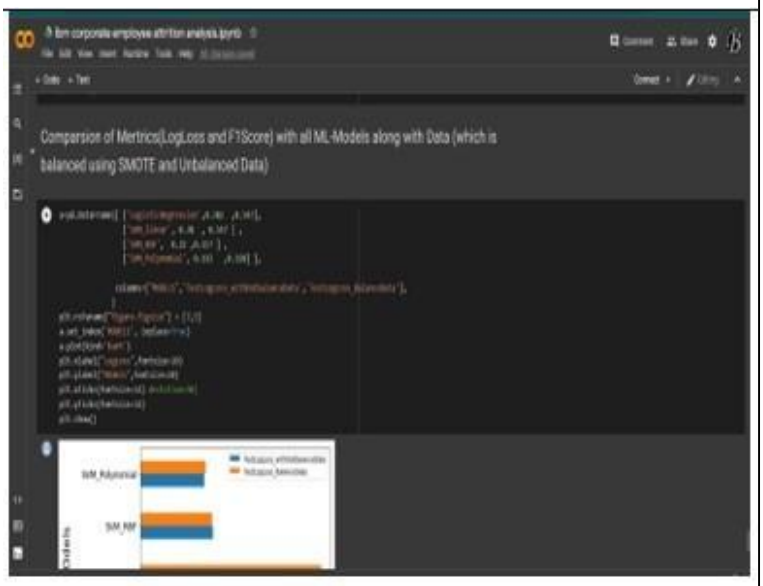
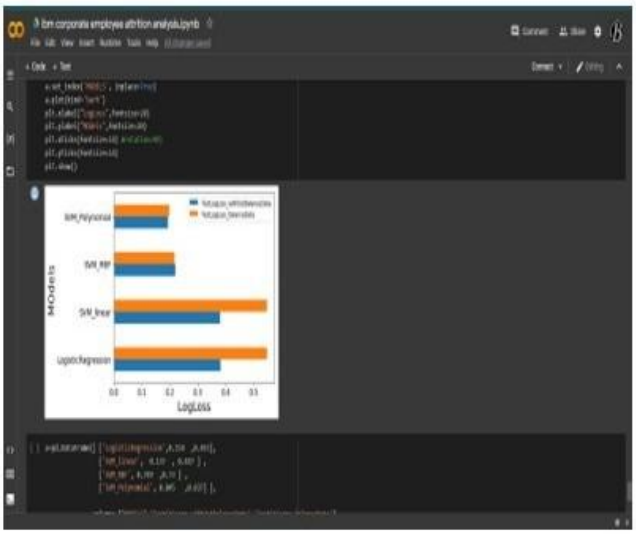
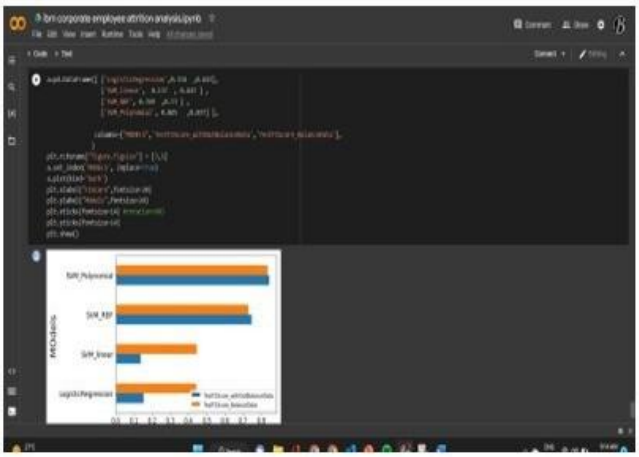
Project team shall fill the following information in model performance testing template.

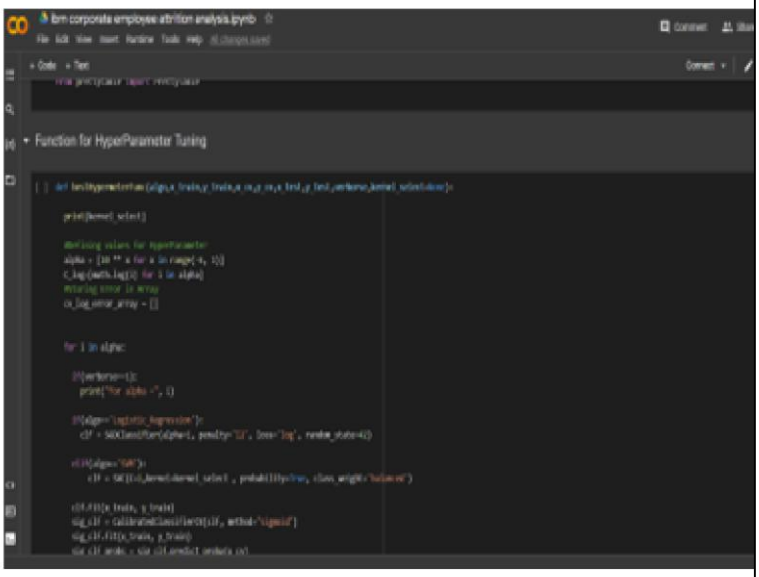
S.No.	Parameter	Values	Screenshot

	Metrics	**Regression Model:** R2 score - 79% **Classification Model:** Confusion Matrix - 79% Accuracy Score- 76% & Classification Report – 1.Correlation 2.Confusion matrix 3.Logistic regression 4.Linear SVM 5.RBF Kernel 6.Poly Kernel	  

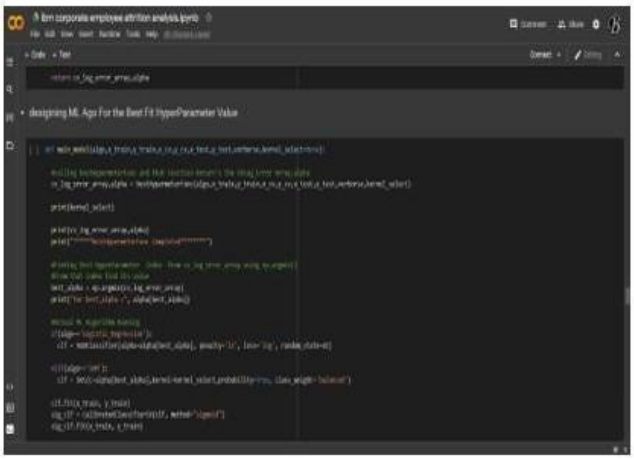

YearsSinceLastPromotion
NumCompaniesWorked
BusinessTravel_Travel_Frequently
MaritalStatus_Single
JobRole_Research Director
EducationField_Human Resources
JobRole_Sales Executive
EducationField_Life Sciences
PercentSalaryHike
Department_Human Resources
EmployeeID
Gender_Male
PerformanceRating
JobRole_Healthcare Representative
EducationField_Medical
JobRole_Laboratory Technician
Department_Research & Development
JobRole_Research Scientist
StandardHours
Over18_Y
EmployeeCount
JobRole_Human Resources
EducationField_Marketing
Department_Sales
JobRole_Sales Representative
Gender_Female
Education
DistanceFromHome
JobInvolvement
StockOptionLevel
BusinessTravel_Travel_Rarely
MonthlyIncome
YearsAtCompany
JobLevel
EducationField_Technical Degree
EducationField_Other
JobRole_Manager
MaritalStatus_Married
JobRole_Manufacturing Director
MaritalStatus_Divorced
TrainingTimesLastYear
WorkLifeBalance
BusinessTravel_Non-Travel
Age
EnvironmentSatisfaction
JobSatisfaction
TotalWorkingYears
YearsWithCurrManager
−0.4
−0.2
0.0
0.2


ibm corporate employee attrition analysis.ipynb
File Edit View Insert Runtime Tools Help
+ Code + Text
SVM
Using Linear Kernal

2.	Tune the Model	Hyperparameter Tuning – 80% Validation Method – 1.predictive analysis 2.svm model 3. poly kernel 4. RBF Kernel 5.regression analysis	  


ibm corporate employee attrition analysis.ipynb
Function for HyperParamster Tuning

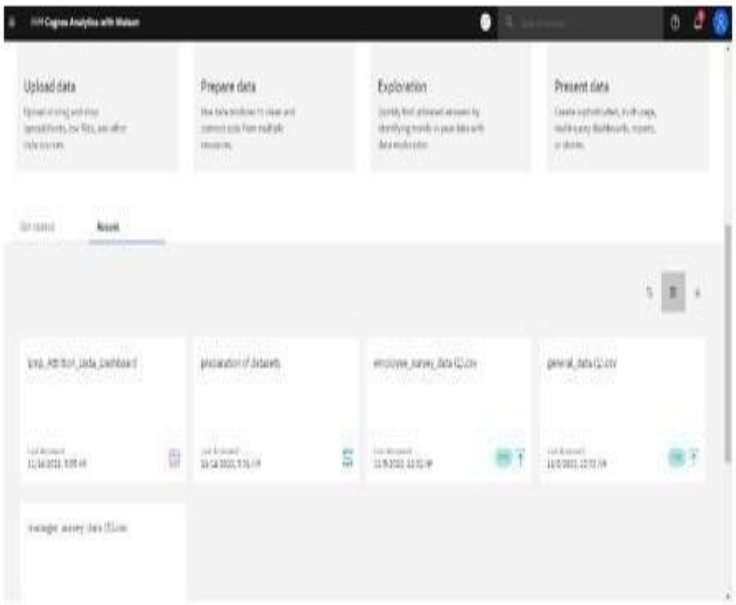
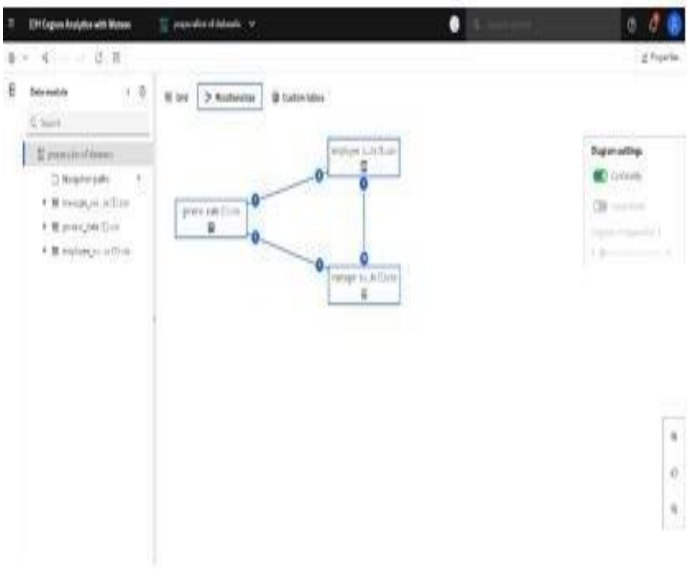

ibm corporate employee attrition analysis.ipynb
designing ML Algo For the Best Fit HyperParameter Value

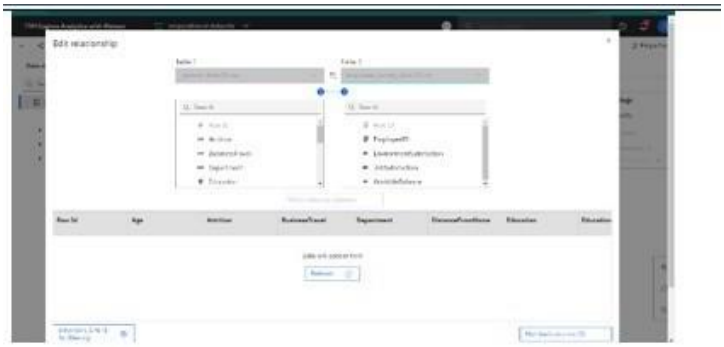

ibm corporate employee attrition analysis.ipynb
designing ML Algo For the Best Fit HyperParameter Value

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

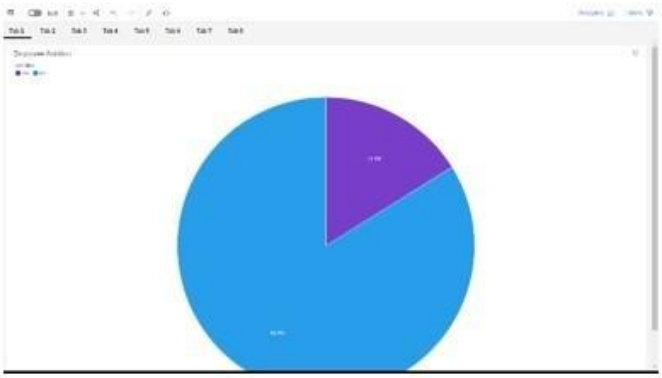
S.No.	Parameter	Screenshot / Values

1.	Dashboard design	No of Visulizations / Graphs – 8 LOADING THE DATASET:  PREPARING THE DATA & EXPLORATION OF DATA: 

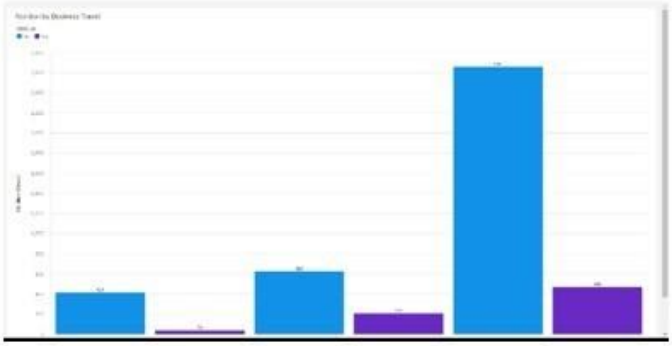


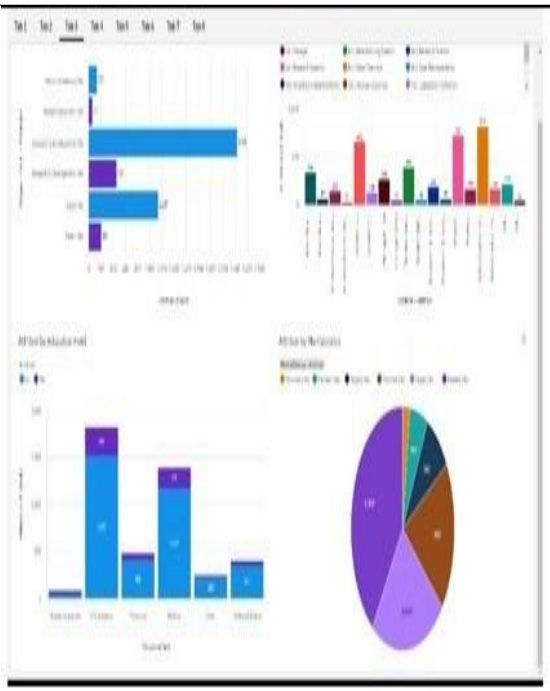
CREATION OF VISUALIZATION CHARTS

EMPLOYEE ATTRITION STATUS:

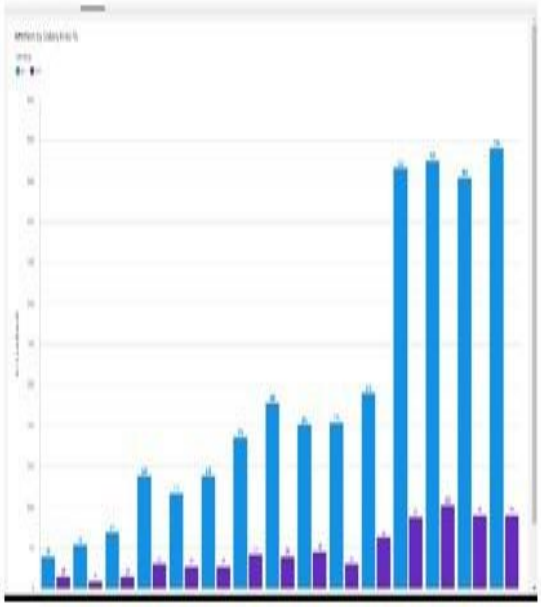


ATTRITION BY BUSINESS TRAVEL:



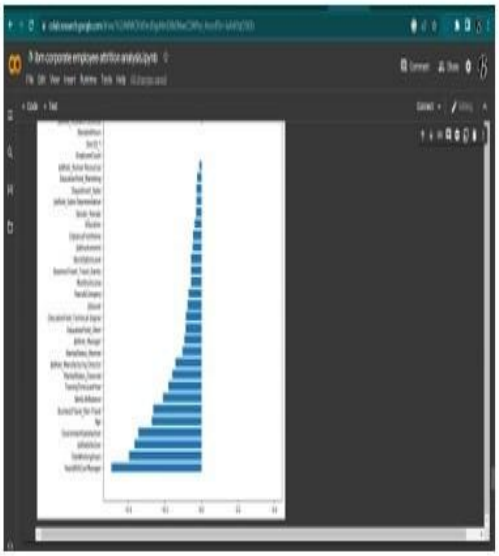


ATTRITION BY SALARY HIKE PERCENT:

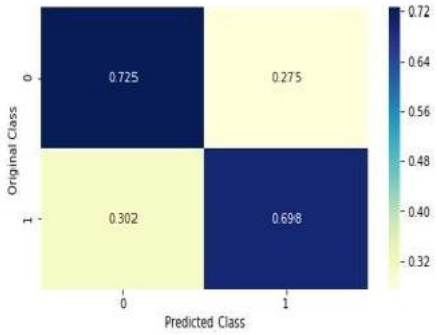


Model Performance Testing:

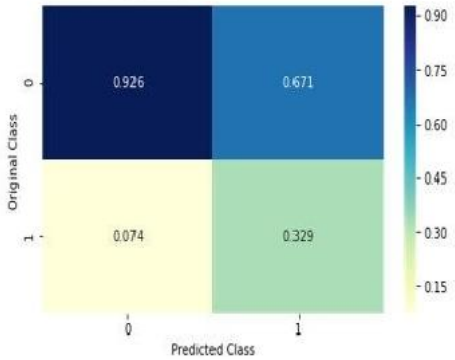
Project team shall fill the following information in model performance testing template.

S.No.	Parameter	Values	Screenshot
1.	Model Summary Regression analysis	for best_alpha = 0.01 For values of best alpha = 0.01 The train log loss is: 0.3571556733065044 For values of best alpha = 0.01 The cross validation log loss is: 0.38726151334759856 For values of best alpha = 0.01 The test log loss is: 0.3819696610792824 +----------+----------+----------+----------+ | Metric | Train value | CV value | Test value | +----------+----------+----------+----------+ | Log-Loss | 0.357 | 0.387 | 0.382 | | Precision | 0.771 | 0.824 | 0.706 | | Recall | 0.144 | 0.126 | 0.086 | | F1-Score | 0.242 | 0.219 | 0.154 | | Accuracy | 0.855 | 0.855 | 0.847 |	
	SVM Model	linear linear [0.4001705021624625, 0.40017050214069255, 0.4001705020945628, 0.3930644655688551, 0.392335542092979, 0.392432524331171, 0.3927347253426151] [1e-06, 1e-05, 0.0001, 0.001, 0.01, 0.1, 1] ******bestHypermeterFunc Completed******** for best_alpha = 0.01 For values of best alpha = 0.01 The train log loss is: 0.3605788274237615 For values of best alpha = 0.01 The cross validation log loss is: 0.392335542092979 For values of best alpha = 0.01 The test log loss is: 0.37951616221945994 +----------+----------+----------+----------+ | Metric | Train value | CV value | Test value | +----------+----------+----------+----------+ | Log-Loss | 0.361 | 0.392 | 0.38 | | Precision | 0.652 | 0.75 | 0.5 | | Recall | 0.097 | 0.135 | 0.079 | | F1-Score | 0.168 | 0.229 | 0.137 | | Accuracy | 0.846 | 0.853 | 0.838 | +----------+----------+----------+----------+ **********	

---------- Recall ----------

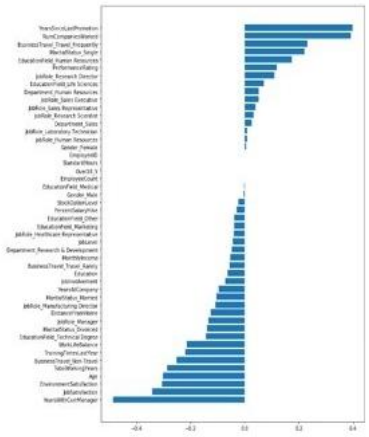


---------- Precision ----------

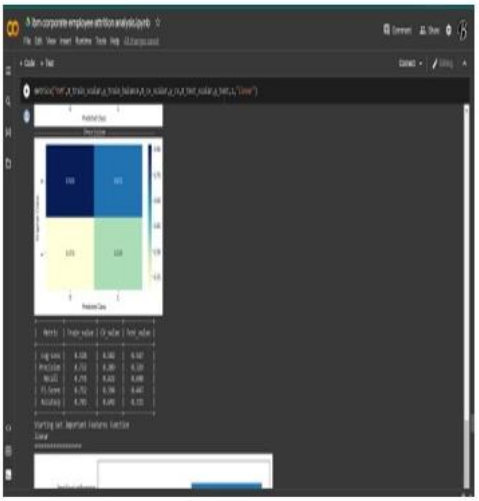


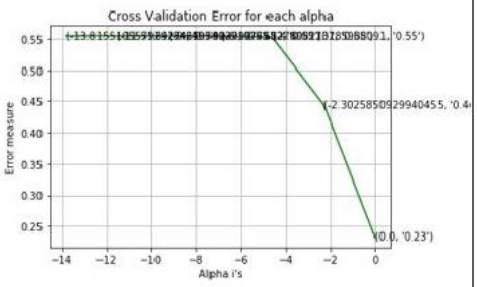
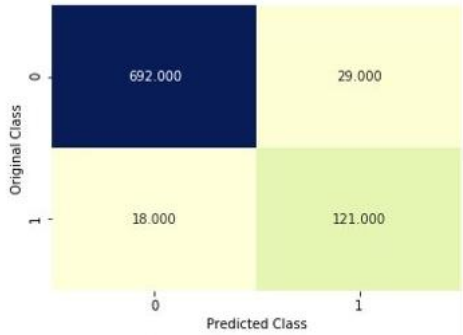
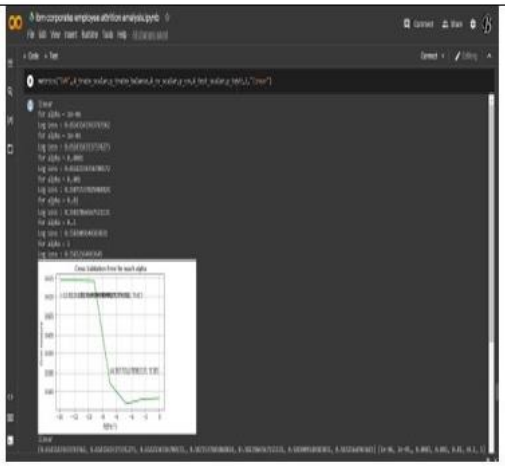
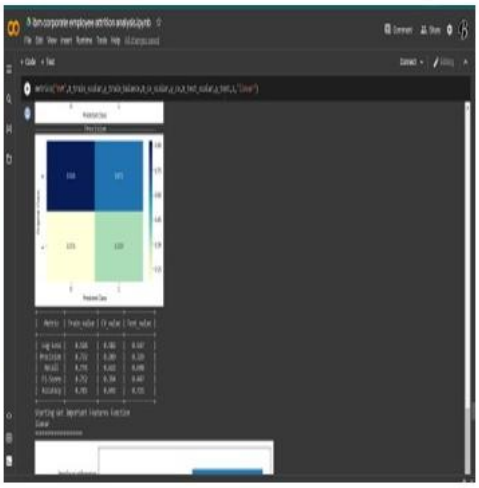
Metric	Train value	CV value	Test value
Log-Loss	0.528	0.582	0.547
Precision	0.732	0.289	0.329
Recall	0.774	0.622	0.698
F1-Score	0.752	0.394	0.447
Accuracy	0.745	0.692	0.721

Starting Get Important Features Function
linear
****



Validation Accuracy – 76%



3.	Confidence Score (Only Volo Projects)	Confidence Score – for alpha = 1e-06 Log Loss : 0.5544280465616621 for alpha = 1e-05 Log Loss : 0.5544279653425883 for alpha = 0.0001 Log Loss : 0.5544279626082605 for alpha = 0.001 Log Loss : 0.554427965596575 for alpha = 0.01 Log Loss : 0.5520345548670238 for alpha = 0.1 Log Loss : 0.4446536394141772 for alpha = 1 Log Loss : 0.23267354410235444  poly [0.5544280465616621, 0.5544279653425883, 0.5544279626082605, 0.554427965596575, 0.5520345548670238, 0.4446536394141772, 0.23267354410235444] [1e-06, 1e-05, 0.0001, 0.001, 0.01, 0.1, 1] ******bestHyperpmeterFunc Completed******** for best_alpha = 1 For values of best alpha = 1 The train log loss is: 0.05843126754768401 For values of best alpha = 1 The cross validation log loss is: 0.23267354410235444 0.23267354410235444 For values of best alpha = 1 The test log loss is: 0.19790587725653494 ---------- Confusion Matrix ----------  ---------- Recall ----------	  

10. ADVANTAGES & DISADVANTAGES

CURRENT High Turnover	ALTERNATIVE High Retention
• Cost: 16-212% employee annual salary per lost employee • Lost productivity • Disrupted work environment • Low morale • Increased miscommunication • More mistakes or accidents • Low employee engagement and little employee-driven improvement	• Greater profits (from increased sales as well as saving on costs) • Better workplace culture • Stronger employee relationships • Improved communication • Higher workplace morale • Happier customers and more promoters • Employee-driven innovation

11. CONCLUSION

The following suggestion are given based on the analysis and modelling result:

CURRENT EMPLOYEES:

•Work life balance should be improved

•Work environment should be improved

•The manager of an employee should not be changed very often

•Employees should be provided relevant training regularly, especially for its younger employees

FUTURE EMPLOYEES (CHANGES IN HIRING PROCESS):

- The company should follow either one of the strategies given below –
  - Hire older people with decent work experience
  - Hire young people and train them appropriately
- It could also opt for a combination of the two

12. FUTURE SCOPE

The future scope of the research is that these analysis and modelling helps in forecasting the cause of employee disengagement, enables HR managers develop long-term strategies to reduce attrition, Competitive measures to enhance company brand image, Develops and shapes drills that benefit both the management and the employees. The scope of this research can be extended to many numbers of samples and to other working fields other than corporates

13. APPENDIX

Nowadays, employee attrition became a serious issue regarding a company's competitive advantage. It's very expensive to find, hire and train new talents. It's more cost-effective to keep the employees a company already has. A company needs to maintain a pleasant working atmosphere to make their employees stay in that company for a longer period. A few years back it was done manually but itis an era of machine learning and data analytics. Now, a company's HR department uses some data analytics tool to identify which areas to be modified to make most of its employees to stay.

Why are we using logistic regression to analyze employee attrition?

Whether an employee is going to stay or leave a company, his or her answer is just binomial i.e. it can be "YES" or "NO". So, we can see our dependent variable Employee Attrition is just a categorical variable. In the case of a dependent categorical variable, we can not use linear regression, in that case, we have to use "LOGISTIC REGRESSION".

Methodology

Here, I am going to use 5 simple steps to analyze Employee Attrition using Rsoftware

1. DATA COLLECTION
2. DATA PRE PROCESSING
3. DIVIDING THE DATA into TWO PARTS "TRAINING" AND "TESTING"
4. BUILD UP THE MODEL USING "TRAINING DATA SET"
5. DO THE ACCURACY TEST USING "TESTING DATA SET"

Data Exploration

A large company named XYZ, employs, at any given point of time, around 4000 employees. However, every year, around 15% of its employees leave the company. Since the attrition level is too high, the management wants to use predictive modelling to bring it down.

Hence, the objectives of the analysis are to:

•Help company XYZ identify current employees that are very likely to leave

•Recommend ways for company XYZ to decrease its attrition level in the future

The analysis is divided into three parts:

•Data Understanding – Source of data, patterns in the data

•Predictive modelling of attrition

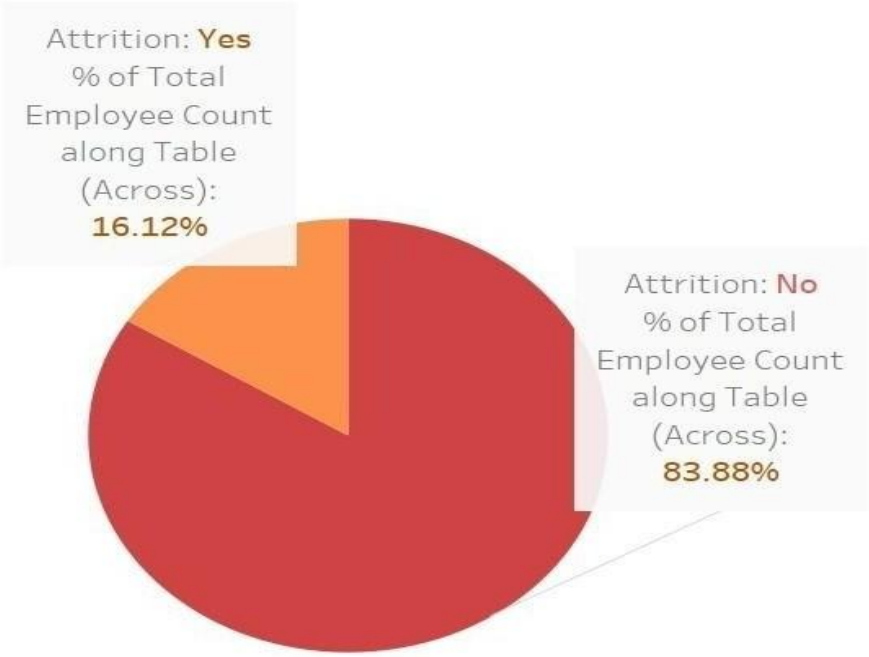
•Recommending ways for company XYZ to decrease its level of attrition

A quick look at the dataset:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Attrition	BusinessTra	DailyRate	Departmen	DistanceFrc	Education	EducationFi	EmployeeC	EmployeeN	Environmer	Gender	HourlyRate	JobInvolver	JobLevel	JobRole	JobSatisfact	MaritalStat
2	Yes	Travel_Rare	1102	Sales	1	2	Life Science	1	1	2	Female	94	3	2	Sales Execu	4	Single
3	No	Travel_Frec	279	Research &	8	1	Life Science	1	2	3	Male	61	2	2	Research Sc	2	Married
4	Yes	Travel_Rare	1373	Research &	2	2	Other	1	4	4	Male	92	2	1	Laboratory	3	Single
5	No	Travel_Frec	1392	Research &	3	4	Life Science	1	5	4	Female	56	3	1	Research Sc	3	Married
6	No	Travel_Rare	591	Research &	2	1	Medical	1	7	1	Male	40	3	1	Laboratory	2	Married
7	No	Travel_Frec	1005	Research &	2	2	Life Science	1	8	4	Male	79	3	1	Laboratory	4	Single
8	No	Travel_Rare	1324	Research &	3	3	Medical	1	10	3	Female	81	4	1	Laboratory	1	Married
9	No	Travel_Rare	1358	Research &	24	1	Life Science	1	11	4	Male	67	3	1	Laboratory	3	Divorced
10	No	Travel_Frec	216	Research &	23	3	Life Science	1	12	4	Male	44	2	3	Manufactur	3	Single
11	No	Travel_Rare	1299	Research &	27	3	Medical	1	13	3	Male	94	3	2	Healthcare	3	Married
12	No	Travel_Rare	809	Research &	16	3	Medical	1	14	1	Male	84	4	1	Laboratory	2	Married
13	No	Travel_Rare	153	Research &	15	2	Life Science	1	15	4	Female	49	2	2	Laboratory	3	Single
14	No	Travel_Rare	670	Research &	26	1	Life Science	1	16	1	Male	31	3	1	Research Sc	3	Divorced
15	No	Travel_Rare	1346	Research &	19	2	Medical	1	18	2	Male	93	3	1	Laboratory	4	Divorced
16	Yes	Travel_Rare	103	Research &	24	3	Life Science	1	19	3	Male	50	2	1	Laboratory	3	Single
17	No	Travel_Rare	1389	Research &	21	4	Life Science	1	20	2	Female	51	4	3	Manufactur	1	Divorced
18	No	Travel_Rare	334	Research &	5	2	Life Science	1	21	1	Male	80	4	1	Research Sc	2	Divorced
19	No	Non-Travel	1123	Research &	16	2	Medical	1	22	4	Male	96	4	1	Laboratory	4	Divorced
20	No	Travel_Rare	1219	Sales	2	4	Life Science	1	23	1	Female	78	2	4	Manager	4	Married
21	No	Travel_Rare	371	Research &	2	3	Life Science	1	24	4	Male	45	3	1	Research Sc	4	Single
22	No	Non-Travel	673	Research &	11	2	Other	1	26	1	Female	96	4	2	Manufactur	3	Divorced

	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1	MonthlyIncome	MonthlyRate	NumCompaniesW	Over18	OverTime	PercentSal	Performan	Relationshi	StandardH	StockOptio	TotalWorki	TrainingTin	WorkLifeBa	YearsAtCor	YearsInCur	YearsSincel	YearsWithC	Age
2	5993	19479	8	Y	Yes	11	3	1	80	0	8	0	1	6	4	0	5	41
3	5130	24907	1	Y	No	23	4	4	80	1	10	3	3	10	7	1	7	49
4	2090	2396	6	Y	Yes	15	3	2	80	0	7	3	3	0	0	0	0	37
5	2909	23159	1	Y	Yes	11	3	3	80	0	8	3	3	8	7	3	0	33
6	3468	16632	9	Y	No	12	3	4	80	1	6	3	3	2	2	2	2	27
7	3068	11864	0	Y	No	13	3	3	80	0	8	2	2	7	7	3	6	32
8	2670	9964	4	Y	Yes	20	4	1	80	3	12	3	2	1	0	0	0	59
9	2693	13335	1	Y	No	22	4	2	80	1	1	2	3	1	0	0	0	30
10	9526	8787	0	Y	No	21	4	2	80	0	10	2	3	9	7	1	8	38
11	5237	16577	6	Y	No	13	3	2	80	2	17	3	2	7	7	7	7	36
12	2426	16479	0	Y	No	13	3	3	80	1	6	5	3	5	4	0	3	35
13	4193	12682	0	Y	Yes	12	3	4	80	0	10	3	3	9	5	0	8	29
14	2911	15170	1	Y	No	17	3	4	80	1	5	1	2	5	2	4	3	31
15	2661	8758	0	Y	No	11	3	3	80	1	3	2	3	2	2	1	2	34
16	2028	12947	5	Y	Yes	14	3	2	80	0	6	4	3	4	2	0	3	28
17	9980	10195	1	Y	No	11	3	3	80	1	10	1	3	10	9	8	8	29
18	3298	15053	0	Y	Yes	12	3	4	80	2	7	5	2	6	2	0	5	32
19	2935	7324	1	Y	Yes	13	3	2	80	2	1	2	2	1	0	0	0	22
20	15427	22021	2	Y	No	16	3	3	80	0	31	3	3	25	8	3	7	53
21	3944	4306	5	Y	Yes	11	3	3	80	0	6	3	3	3	2	1	2	38
22	4011	8232	0	Y	No	18	3	4	80	1	5	5	2	4	2	1	3	24
23	3407	6986	7	Y	No	23	4	2	80	0	10	4	3	5	3	0	3	36
24	11994	21293	0	Y	No	11	3	3	80	0	13	4	3	12	6	2	11	34
25	1232	19281	1	Y	No	14	3	4	80	0	0	6	3	0	0	0	0	21
26	2960	17102	2	Y	No	11	3	3	80	0	8	2	3	4	2	1	3	34

Take a look:



Data preparation

- ## Detect the missing values:
- We have to see if there are any missing values in the dataset.

```
anyNA(JOB_Attrition)
```

- Result: FALSE; i.e. there are no missing values in our data set ”JOB_Attrition”

- ## Change the data types:
- First of all, we have to change the data type of the dependent variable “Attrition”. It is given as “Yes” and “No” form i.e. it is a categorical variable.To make a proper model we have to convert it into numeric form. To do so,we will assign value 1 to “Yes” and value 0 to “No” and convert it into numeric.

```
JOB_Attrition$Attrition[JOB_Attrition$Attrition=="Yes"]=1
JOB_Attrition$Attrition[JOB_Attrition$Attrition=="No"]=0
JOB_Attrition$Attrition=as.numeric(JOB_Attrition$Attrition)
```

- Next, we will change all “character” variables into “Factor”
- There are 8 character variables: Business Travel, Department, Education, Education Field, Gender, Job role, Marital Status, Over Time. There columnnumbers are 2,4,6,7,11,15,17,22 respectively.

```
JOB_Attrition[,c(2,4,6,7,11,15,17,22)]=lapply(JOB_Attrition[,c(2,4,6,7,11,15,17,22)],as.factor)
```

- Lastly, there is one other variable ” Over 18″ which has all inputs as “Y”. It is also a character variable. We will transform into numeric as it has only one level so transforming into factor will not provide a good result. To do so, we will assign value 1 to “Y” and transform it into numeric.

```
JOB_Attrition$Over18[JOB_Attrition$Over18=="Y"]=1
JOB_Attrition$Over18=as.numeric(JOB_Attrition$Over18)
```

Splitting the dataset into “training” and“testing”

In any regression analysis, we have to split the dataset into 2 parts:

1. TRAINING DATA SET
2. TESTING DATA SET

With the help of the Training data set we will build up our model and test its accuracy using the Testing Data set.

```
set.seed(1000)
ranuni=sample(x=c("Training","Testing"),size=nrow(JOB_Attrition),replace=T,prob=c(0.7,0.3)
)
TrainingData=JOB_Attrition[ranuni=="Training",
]
TestingData=JOB_Attrition[ranuni=="Testing",]
nrow(TrainingData) nrow(TestingData)
```

We have successfully split the whole data set into two parts. Now we have 1025 Training data & 445 Testing data.

Building up the model

We are now going to build up the model following some simple steps as follows:

1. Identify the independent variables

2. Incorporate the dependent variable “Attrition” in the model
3. Transform the data type of model from “character” to “formula”
4. Incorporate TRAINING data into the formula and build the model

```
independentvariables=colnames(JOB_Attrition[,2:35])
independentvariables
Model=paste(independentvariables,collapse="+")
Model
Model_1=paste("Attrition~",Model)
Model_1
class(Model_1)
formula=as.formula(Model_1)
formula
```

Output:

```
> formula
Attrition ~ BusinessTravel + DailyRate + Department + DistanceFromHome +
    Education + EducationField + EmployeeCount + EmployeeNumber +
    EnvironmentSatisfaction + Gender + HourlyRate + JobInvolvement +
    JobLevel + JobRole + JobSatisfaction + MaritalStatus + MonthlyIncome +
    MonthlyRate + NumCompaniesWorked + Over18 + OverTime + PercentSalaryHike +
    PerformanceRating + RelationshipSatisfaction + StandardHours +
    StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
    WorkLifeBalance + YearsAtCompany + YearsInCurrentRole + YearsSinceLastPromotion +
    YearsWithCurrManager + Age
```

Next, we will incorporate “Training Data” into the formula using the “glm” function and build up a logistic regression model.

```
Trainingmodel1=glm(formula=formula,data=TrainingData,family="binomial")
```

Now, we are going to design the model by the “Stepwise selection” method to fetch significant variables of the model. Execution of the code will give us a list ofoutput where the variables are added and removed based on our significance of the model. The AIC value at each level reflects the goodness of the respective model. As the value keeps dropping it leads to a better fitting logistic regression model.

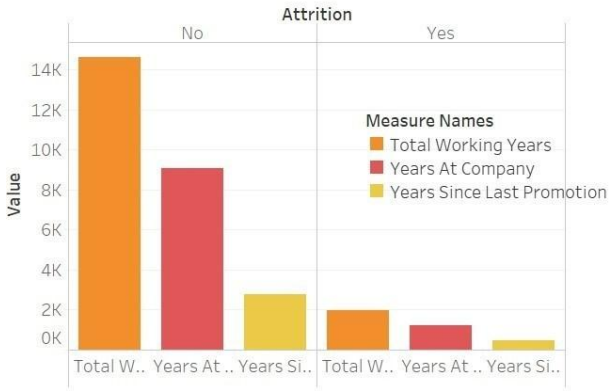
The application of the summary on the final model will give us the list of finalsignificant variables and their respective important information.

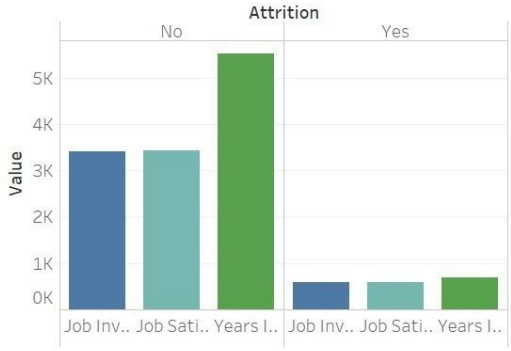
```
Trainingmodel1=step(object = Trainingmodel1,direction = "both")
summary(Trainingmodel1)
```

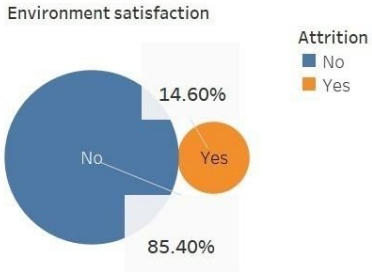
```
                                  Estimate Std. Error z value Pr(>|z|)
(Intercept)                        2.39506    1.54588   1.549 0.121306
BusinessTravelTravel_Frequently    2.27473    0.54975   4.138 3.51e-05 ***
BusinessTravelTravel_Rarely        1.22619    0.51430   2.384 0.017117 *
DistanceFromHome                   0.04415    0.01299   3.400 0.000675 ***
EducationFieldLife Sciences       -0.64408    0.97046  -0.664 0.506894
EducationFieldMarketing            0.31719    1.03345   0.307 0.758906
EducationFieldMedical             -0.78963    0.97159  -0.813 0.416378
EducationFieldOther               -0.57202    1.07902  -0.530 0.596023
EducationFieldTechnical Degree     0.24200    0.99122   0.244 0.807121
EnvironmentSatisfaction           -0.43843    0.10244  -4.280 1.87e-05 ***
GenderMale                         0.43233    0.22638   1.910 0.056162 .
JobInvolvement                    -0.52721    0.14711  -3.584 0.000339 ***
JobRoleHuman Resources             1.52115    0.81078   1.876 0.060634 .
JobRoleLaboratory Technician       1.33100    0.54552   2.440 0.014692 *
JobRoleManager                     0.41330    0.79632   0.519 0.603753
JobRoleManufacturing Director      0.47421    0.62340   0.761 0.446848
JobRoleResearch Director         -15.78918  703.79094  -0.022 0.982101
JobRoleResearch Scientist          0.58586    0.54412   1.077 0.281608
JobRoleSales Executive             0.75873    0.55817   1.359 0.174041
JobRoleSales Representative        1.42601    0.63391   2.250 0.024479 *
JobSatisfaction                   -0.34296    0.09875  -3.473 0.000515 ***
MaritalStatusMarried               0.47517    0.31249   1.521 0.128365
MaritalStatusSingle                1.45219    0.32090   4.525 6.03e-06 ***
NumCompaniesWorked                 0.19962    0.04821   4.140 3.47e-05 ***
OverTimeYes                        1.92209    0.23446   8.198 2.44e-16 ***
PercentSalaryHike                 -0.04655    0.03199  -1.455 0.145653
RelationshipSatisfaction          -0.35975    0.10090  -3.565 0.000363 ***
TotalWorkingYears                 -0.11388    0.03519  -3.236 0.001213 **
TrainingTimesLastYear             -0.22353    0.09093  -2.458 0.013964 *
WorkLifeBalance                   -0.34294    0.14989  -2.288 0.022138 *
YearsAtCompany                     0.13557    0.04963   2.731 0.006309 **
YearsInCurrentRole                -0.19590    0.05846  -3.351 0.000805 ***
YearsSinceLastPromotion            0.14191    0.05045   2.813 0.004909 **
YearsWithCurrManager              -0.10590    0.05871  -1.804 0.071286 .
Age                               -0.02582    0.01623  -1.591 0.111630
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 891.31  on 1024  degrees of freedom
Residual deviance: 581.72  on  990  degrees of freedom
AIC: 651.72

Number of Fisher Scoring iterations: 17
```

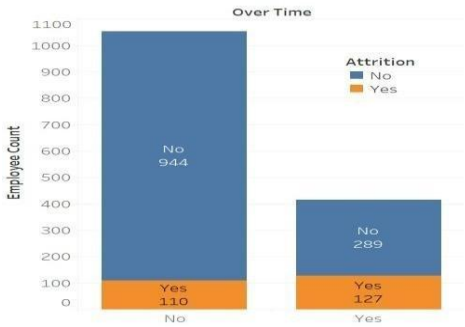
From our above result we can see, Business travel, Distance from home, Environment satisfaction, Job involvement, Job satisfaction, Marital status, Number of companies worked, Over time, Relationship satisfaction, Total working years, Years at the company, years since last promotion, years in the current role all these are most significant variables in determining employee attrition. If the company mostly looks after these areas then there will be a lesser chance of losing an employee.

A quick visualization to see how much these variables affect “attrition”









Here I have used Tableau for these visualizations; isn't it beautiful? This software just makes our work easier.

Now, we can perform the Hoshmer-Lemeshow goodness of fit test on the data set, to judge the accuracy of the predicted probability of the model.

The hypothesis is:

H0: The model is a good fit.

H1: The model is not a good fit.

If, p-value>0.05 we will accept H0 and reject H1.

To perform the test in R we need to install the mkMisc package.

```
HLgof.test(fit=Trainingmodel1$fitted.values,obs=Trainingmodel1$y)
```

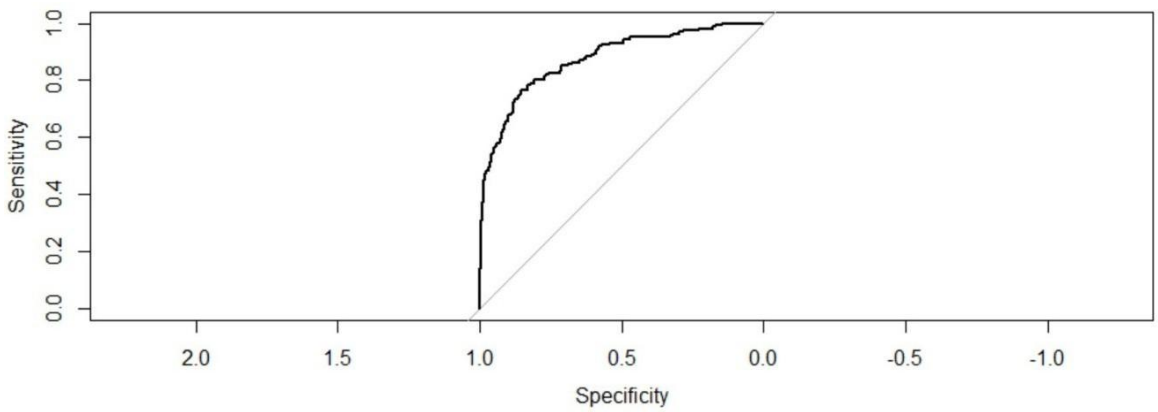
```
        Hosmer-Lemeshow H statistic

data:  Trainingmodel1$fitted.values and Trainingmodel1$y
X-squared = 11.555, df = 8, p-value = 0.1722
```

Here, we can see the p-value is greater than 0.05, hence we will accept H0. Now, it is proved that our model is a well fitted one.

Generating a ROC curve for training data

Another technique to analyze the goodness of fit of logistic regression is the ROC measures(Receiver Operating characteristics). The ROC measures are sensitivity, 1Specificity, False Positive, and False Negative. The two measures we use extensively are Sensitivity and Specificity. The sensitivity measures the goodness of accuracy of the model while specificity measures the weakness of the model. To do this in R we need to install a package pROC.

```
troc=roc(response=Trainingmodel1$y,predictor = Trainingmodel1$fitted.values,plot=T)
troc$auc
```



The area under the curve: 0.8759

Interpretation of the figure:

The plot of these two measures gives us a concave plot which shows as sensitivity is increasing 1-specificity is increasing but at a diminishing rate. The C-value(AUC) or the value of the concordance index gives the measure of the area under the ROC curve. If c=0.5 then it would have meant that the model can not perfectly discriminate between 0 and 1 responses. Then it implies that the initial model cannot perfectly say which employees are going to leave and who are going to stay.

But, here we can see our c-value is far greater than 0.5. It is 0.8759. Our model can perfectly discriminate between 0 and 1. Hence, we can successfully conclude it is a well-fitted model.

Creating the classification table for the training data set:

```
trpred=ifelse(test=Trainingmodel1$fitted.values>0.5,yes = 1,no=0)
table(Trainingmodel1$y,trpred)
```

The above code states, the predicted value of the probability greater than 0,.5 then the value of the status is 1 else it is 0. based on this criterion this code relabels 'Yes' and 'No' Responses of "Attrition". Now, it is important to understand the percentage of predictions that match the initial belief obtained from the data set. Here we will compare (1-1) and (0-0) pair.

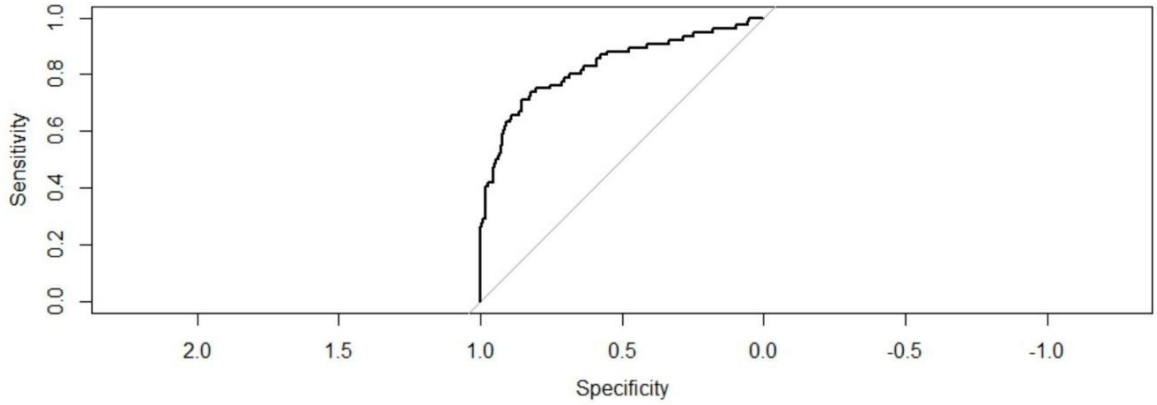
We have 1025 training data. We have predicted {(839+78)/1025}*100=89%correctly.

Comparing the result with testing data:

We will now compare the model with testing data. It is much like an accuracy test.

```
testpred=predict.glm(object=Trainingmodel1,newdata=TestingData,type = "response")
testpred
tsroc=roc(response=TestingData$Attrition,predictor = testpred,plot=T)
tsroc$auc
```

Now, We have incorporated Testing data into the training model and will see the ROC.



The area under the curve: 0.8286(c-value). It is also far higher than 0.5. It is also a well-fitted model.

Creating the classification table for the testing data set

```
testpred=ifelse(test=testpred>0.5,yes=1,no=0)
table(TestingData$Attrition,testpred)
```

```
> table(TestingData$Attrition,testpred)
   testpred
      0   1
  0 362   7
  1  48  28
```

We have 445 Testing data. we have correctly predicted {(362+28)/445}*100=87.64%.

Consequently, we can say, our logistic regression model is a very good fitted model. Any employee attrition data set can be analyzed using this model.

What do you think is it a good model? Comment below

CONCLUSION:

We have successfully learned how to analyze employee attrition using "LOGISTIC REGRESSION" with the help of R software. Only with a couple of codes and a proper data set, a company can easily understand which areas needed to look after to make the workplace more comfortable for their employees and restore their human resource power for a longer period.
We are confident that we will continue to grow and develop professionally and in my personal endeavours. Within my internship, there were two distinct learning experiences that stand out to me as the most influential aspects of my development this semester: community involvement in discussion forum and self-learning.

Through the application of time management, organization, discipline and consistent practice, our self exploration and learning skills improved greatly. Additionally, my development both with the project we were given with and planning and implementing the same directly impacted our academic gain.

Link to code and executable file

https://github.com/IBM-EPBL/IBM-Project-28917-1660118902